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AMERICAN EXPORT CORN (MAIZE) IN EUROPE.

BY

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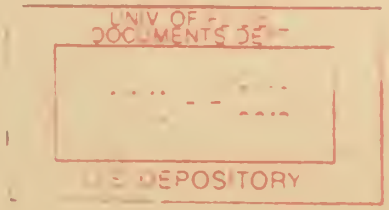

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AMERICAN EXPORT CORN (MAIZE) IN EUROPE.

INTRODUCTION.

PRODUCTION AND EXPORTS OF CORN.

Statistics as given in the various Yearbooks of the Department of Agriculture show that the quantity of corn (maize) produced in the United States during a period of ten years, from 1898 to 1907, inclusive, was 23,092,986,802 bushels. During the same period there were shipped out of the counties where it was grown 4,733,298,990 bushels, or 20.5 per cent of the production, the remaining 79.5 per cent presumably being used on the farm or in the counties where it was grown.

For a corresponding period of ten years beginning July 1, 1898, and ended June 30, 1908, the domestic exports of corn (corn meal not included) were 1,060,856,485 bushels, or 4.6 per cent of the production and 22.4 per cent of the quantity shipped out of the counties where grown, the quantity shipped out of the producing counties constituting practically the whole of the possible commerce in corn of the United States.

THE VALUE OF THE EXPORT TRADE IN CORN.

Corn is, in number of bushels, the principal grain that enters into the export grain trade of the United States. The percentage of corn that is exported, while but a small proportion of the total production, is in point of the percentages of the possible commerce in corn, the number of bushels exported, and the money values involved an enormous trade, which naturally has an important bearing upon the present and prospective wealth of the country. The prices that are obtainable for the corn exported are naturally influenced to a great degree by the quality and condition of the corn at the time it is laid down in foreign countries, and the foreign prices obtainable have in turn been an influential factor in fixing its domestic values.

EUROPEAN COMPLAINTS.

For several years an increasingly large number of more or less forcible and persistent representations were made to the Secretary of Agriculture and other officers of the Federal Government, to the effect that much of the grain, and especially the corn, that was being exported from the United States was not being delivered abroad in a

satisfactory condition, that it was not of the quality represented by the inspection certificates accompanying the shipments, and that material injury was in consequence being done to the export grain trade of the United States.

INVESTIGATIONS BEGUN.

In order to secure definite and reliable information regarding the condition in which American grain was arriving in European countries, an investigation was undertaken by the United States Department of Agriculture. As most of the dissatisfaction seemed to arise from shipments of corn, special attention was given to that grain. Under instructions from the Chief of the Bureau of Plant Industry, Mr. Clyde E. Leighty, one of the writers of this paper, was engaged upon the work for a period extending from January 22 to June 30, 1906, during which time he visited eight of the more important European grain-receiving ports and made examinations of the corn in thirty-two ships arriving from the United States.

INVESTIGATIONS CONTINUED.

Continuing the investigations in order to secure additional data and to verify that already obtained, Mr. Emil G. Boerner, also one of the writers, was engaged upon the work for two periods, one period extending from October 21, 1906, to June 15, 1907, and the other extending from December 20, 1907, to October 30, 1908. During the first period 88 corn-laden ships were examined at 22 European ports and during the second period 53 ships containing corn were examined at 12 European ports, all of the shipments having been made from the various Atlantic and Gulf ports of the United States.

EUROPEAN CONDITIONS STUDIED.

Under instructions from the Secretary of Agriculture and the Chief of the Bureau of Plant Industry, Mr. John D. Shanahan, in immediate charge of the work, was engaged during August, September, and October, 1908, in reviewing these investigations and studying grain-trade conditions in Europe, during which time he visited practically all of the important European grain-importing countries in which American grain is received and nearly all of the principal grain markets and grain-receiving ports in those countries.

The results of these investigations are here set forth in a series of tables and diagrams, together with such conclusions as could be drawn from and recommendations that were suggested by the work. It is believed that the information is of a character which, if placed before the grain industry of the United States, will exert an influence toward the use of more care in the handling and shipping of corn and toward placing our export grain business on a more satisfactory and profitable basis.

THE RESULTS OF INVESTIGATIONS.

SUMMARY OF CARGO EXAMINATION.

The tables and diagrams showing the details of the three seasons' work, collectively, show that a total of 15,077,987 bushels of corn, all of which was certificated as being either "No. 2 Corn," "No. 2 Corn, Sail Grade," or "Prime (Sail) Mixed Corn" (grades of similar requirements as to quality and condition) at the different export points on the Atlantic and Gulf coasts of the United States, and forwarded in 175 steamships, were examined on arrival at the various European grain-receiving ports; that, as a result of careful examinations and estimates, 1,911,374 bushels, or 12.7 per cent, of that total quantity were found on arrival to be in a heating or hot condition, some portions of which were so badly damaged as to be entirely unfit for feeding purposes. The percentage of heating and hot corn varied in the different cargoes and parcels, 100 per cent heating or hot being reached in a total of eight cases during the whole of the three seasons.

EXPLANATION OF THE TERMS USED IN TABLES.

The columns headed "Date of loading" in the tables, except where otherwise specified, show the dates borne on the certificates of inspection accompanying the different shipments, and are consequently the dates when the loading at the American port was completed. The columns headed "Days in boat" represent, in most cases, the number of days from the date of loading to the date the samples were drawn in Europe at the time the cargo was being discharged.

The percentages of "Dirt and foreign material" in each case include all finely broken corn particles that would pass through a 26-gauge 10 by 10 mesh wire sieve, and any other material not corn which was found in the samples as drawn. Great care was exercised to obtain samples that would represent the correct average of the dirt and foreign matter in the grain being sampled, the percentages given being determined by actual separations and weighings. All of the samples drawn from the cargoes were placed immediately in air-tight containers in order to guard against any change in their moisture content before being tested.

FACTORS CONCERNING WHICH NO INFORMATION WAS AVAILABLE.

Some of the factors concerning which no data were available, and which no doubt have their own peculiar influence on the condition of corn in ocean transit, include whether or not fermentation had started in the corn at the time of loading; the temperature of the atmosphere and the temperature of the grain at the time of loading; the character and condition in all cases of other freight loaded next to or on top of the grain; the treatment to which the grain was subjected

after loading, including whether or not the ship's hatches were left uncovered during rainy, foggy, or damp weather; and the temperatures encountered by the ship en route after the grain was loaded.

AMERICAN CORN CERTIFICATED AS "NO. 2 CORN," "NO. 2 CORN, SAIL GRADE," OR "PRIME (SAIL) MIXED CORN" EXAMINED IN EUROPE DURING FEBRUARY, MARCH, APRIL, AND MAY, 1906.

Table I shows in detail the results of the personal examination of thirty-four cargoes of corn upon their arrival during February, March, April, and May, 1906, at eight of the principal European grain-receiving ports. These thirty-four ships carried an aggregate of 4,354,681 bushels and were loaded on various dates between December 28, 1905, and May 15, 1906, at seven of the principal Atlantic and Gulf ports of the United States.

Careful examinations and estimates of the corn on board those ships showed that 526,192 bushels, or 12.1 per cent, were in a heating or hot condition, 100 per cent heating or hot being reached in two cases. The length of time the corn was in the vessels varied from thirteen to forty-nine days. The percentages of dirt and foreign material varied from 0.3 of 1 per cent to 3.8 per cent. The moisture content of the cool corn varied from a minimum of 14.4 per cent to a maximum of 19.3 per cent. The percentage of moisture in the heating corn, where such tests were made, varied from 13.8 to 21 per cent.

TABLE I.—*American corn certificated as "No. 2 Corn," "No. 2 Corn, Sail Grade," or "Prime (Sail) Mixed Corn," examined in Europe during February, March, April, and May, 1906, showing the quantity found heating or hot, etc.*

Cargo.	Quantity examined.	Quantity found heating or hot.		Holds occupied.	Date of loading.	Days in boat.	Dirt and foreign matter.	Moisture in cool corn.[a]	Moisture in heating corn.
No.	*Bushels.*	*Bushels.*	*Per cent.*	*No*	*1905.*	*No.*	*Per cent.*	*Per cent.*	*Per cent.*
1	94,285	[b] 3,600	3.8	4	Dec. 28	46	1.6	16.0	.....
2	55,714	1,785	3.2	2	Dec. 29	49	.8	15.5	.....
					1906.				
3	111,429	0	.0	4	Jan. 4	35	.4	14.4	.....
4	209,829	[c] 1,785	.9	4	Jan. 6	35	1.0	14.6	13.8
5	145,714	[d] 1,785	1.2	5	Jan. 13	31	2.5	16.7	.....
6	51,942	[e] 40,140	77.3	1	Jan. 15	33	2.2	19.2	.....
7	85,714	(Slight.)	.0	3	Jan. 16	22	.9	16.6	.....
8	232,882	[c] 788	.3	4	Jan. 20	28	1.8	17.2	16.0
9	150,000	[e] 17,865	11.9	2	Jan. 23	24	2.2	18.2	18.8
10	85,714	[c] 4,810	5.6	2	Jan. 26	22	1.4	18.0	.....
11	249,963	[e] 56,000	22.4	4	Jan. 26	32	.8	17.9	16.0
12	205,994	[c] 7,140	3.5	5	Jan. 29	29	.6	16.8	.....
13	222,754	[c] 2,500	11.2	4	Jan. 31	27	1.8	17.9	18.7
14	145,714	60	.0	4	Feb. 23	19	2.6	16.8	.....
15	166,415	[b] 900	.5	2	Feb. 23	15	3.2	17.9	18.5
16	90,000	[f] 90,000	100.0	3	Feb. 26	26	1.6	17.5	.....
17	43,085	[b c] 360	.8	1	Mar. 1	14	3.8	17.5	18.1
18	302,013	(Slight.)	.0	5	Mar. 6	22	2.4	17.5	.....
19	34,285	0	.0	2	Mar. 12	46	.3	15.0	.....
20	176,209	1,000	.6	2	Mar. 15	19	2.4	17.9	.....
21	147,040	[b c] 2,462	1.7	3	Mar. 30	15	2.3	18.8	18.3

[a] Except where the entire cargo was heating or hot.
[b] Near propeller-shaft tunnel only.
[c] Near engine or boiler room bulkhead only.
[d] Near shifting boards in one hold.
[e] General, but worse near engine and boiler room bulkheads.
[f] In all places of stowage.

TABLE I.—*American corn certificated as "No. 2 Corn," "No. 2 Corn, Sail Grade," or "Prime (Sail) Mixed Corn," examined in Europe during February, March, April, and May, 1906, showing the quantity found heating or hot, etc.* Continued.

Cargo.	Quantity examined.	Quantity found heating or hot.		Holds occupied.	Date of loading.	Days in boat.	Dirt and foreign matter.	Moisture in cool corn.[a]	Moisture in heating corn.
No.	*Bushels.*	*Bushels.*	*Per cent.*	*No.*	*1906.*	*No.*	*Per cent.*	*Per cent.*	*Per cent.*
22	102,857	[b] 7,140	6.9	2	Apr. 1	21	3.2	17.4	21.0
23	25,714	2,570	10.0	1	Apr. 3	24	.5	19.3	
24	25,714	(Slight.)	.0	1	Apr. 4	21	2.7	17.8	
25	185,750	[c] 37,150	20.0	4	Apr. 1	31	.7	18.2	
26	182,094	[d] 22,375	12.3	4	Apr. 5	26	.9	17.6	19.6
27	188,564	[d] 18,856	10.0	5	Apr. 5	26	1.1	16.8	19.2
28	102,412	[e] [f] 461	.5	2	Apr. 10	11	2.5	17.8	17.9
29	177,879	[d] 14,200	8.0	4	Apr. 12	21	1.3	16.6	
30	68,571	[g] 34,285	50.0	2	Apr. 24	24	1.9	18.7	18.6
31	134,365	[d] 106,240	79.4	3	Apr. 27	18	2.9	18.1	18.3
32	102,514	[g] 24,200	23.6	2	Apr. 28	28	1.2	16.4	16.3
33	[h] 25,733	[i] 25,733	100.0	1	May 15	13	.....	.....	.....
34	[h] 25,819	0	.0	1	May 15	13	.....	.....	.....
	4,354,681	526,192	12.1	98					

[a] Except where the entire cargo was heating or hot.
[b] Near engine or boiler room bulkhead, and near shifting boards in one hold.
[c] General, but worse near engine and boiler room bulkheads.
[d] At top of some holds, but principally near engine and boiler room bulkheads.
[e] Near propeller-shaft tunnel only.
[f] Near engine or boiler room bulkhead only.
[g] Principally in upper portions of grain in all holds.
[h] Examined but no samples secured.
[i] In all places of stowage.

Figure 1 illustrates the data contained in Table I and shows the strong tendency in corn to "go out of condition" and heat in ocean transit as the moisture content is increased.

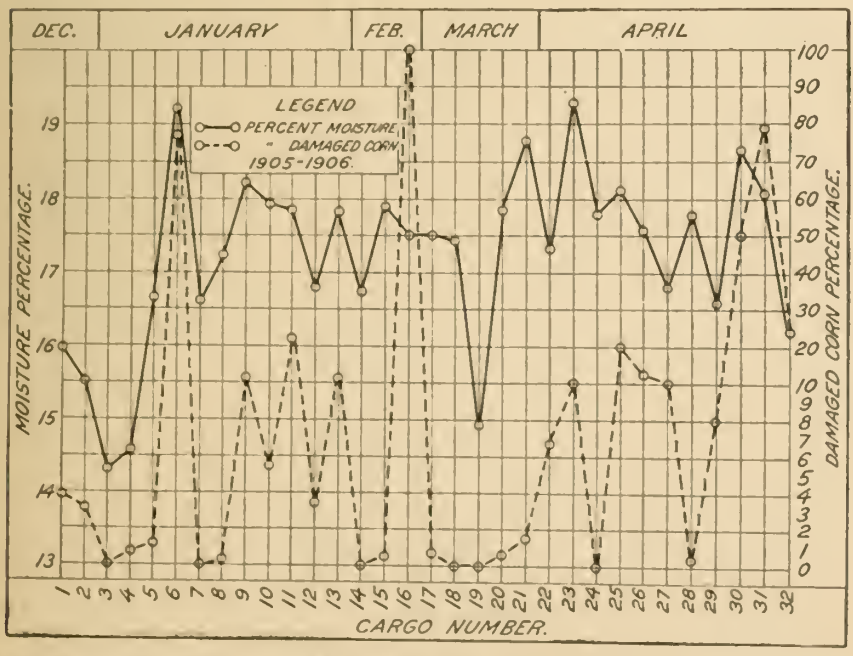

FIG. 1.—Diagram showing in chronological order the cargo number of each shipment, the months during which shipments were made, the percentages of moisture in the corn, and the percentages of corn found damaged in each cargo on arrival in Europe during the season of 1905–6.

AMERICAN CORN CERTIFICATED AS "NO. 2 CORN," "NO. 2 CORN, SAIL GRADE," OR "PRIME (SAIL) MIXED CORN," EXAMINED IN EUROPE FROM NOVEMBER, 1906, TO MAY, 1907, INCLUSIVE.

Table II shows in detail the results of the personal examination of eighty-eight cargoes of corn on their arrival during the months from November, 1906, to May, 1907, inclusive, at the principal European grain-receiving ports. The eighty-eight cargoes contained an aggregate of 6,598,351 bushels, of which quantity 1,120,900 bushels, or 17 per cent, were found to be in a heating or hot condition. The cargoes were loaded at the different Atlantic and Gulf ports in the United States on various dates from October 17, 1906, to May 9, 1907. The corn in forty-five of the cargoes arrived cool throughout. The corn in forty-three of the cargoes was found to be more or less heating or hot, 100 per cent heating or hot being reached in five cargoes aggregating 254,073 bushels.

The length of time that the corn was in the vessels varied from 14 to 58 days. All of the corn which was in the vessels under 16 days arrived cool. One of the cargoes examined was en route 58 days, with 60,000 bushels of corn containing 14.4 per cent of moisture, but sustained no damage. Another cargo carrying 17,142 bushels of corn containing 16.7 per cent of moisture was en route 56 days and 24.5 per cent of the cargo was found to be heating or hot on arrival.

The moisture content of the cool corn examined on arrival during the period varied from 12 to 20.6 per cent, an average of 17.1 per cent. Approximately 2,748,000 bushels, or 50.2 per cent, of the cool corn contained moisture exceeding 18 per cent. The dirt and foreign material, with one exception, varied from 0.2 of 1 per cent to 4.5 per cent. In one cargo, the above exception, one sample analyzed 62.5 per cent of dirt and foreign matter but was representative only of a considerable quantity of corn that was located just under one of the hatches of one of the ships.

TABLE II.—*American corn certificated as "No. 2 Corn," "No. 2 Corn, Sail Grade," or "Prime (Sail) Mixed Corn" examined in Europe from November, 1906, to May, 1907, inclusive, showing the quantity found heating or hot, etc.*

Cargo.	Quantity examined.	Quantity found heating or hot.		Holds occupied.	Date of loading.	Days in boat.	Dirt and foreign matter.	Moisture in cool corn.[a]	Moisture in heating corn.
No.	*Bushels.*	*Bushels.*	*Per cent.*	*No.*	*1906.*	*No.*	*Per cent.*	*Per cent.*	*Per cent.*
101	94,281	0	0.0	4	Oct. 17	24	0.7	12.2	.....
102	32,244	0	.0	1	Oct. 18	54	.6	12.6	.....
103	16,270	0	.0	1	[b] Oct. 19	[c] 20	1.6	12.3	.....
104	34,285	0	.0	1	[b] Oct. 24	[c] 36	.4	12.5	.....
105	21,400	0	.0	1	[b] Oct. 29	[c] 39	4.5	12.7	.....
106	42,857	0	.0	2	[b] Nov. 1	[c] 23	.7	14.1	.....
107	38,920	0	.0	2	[b] Nov. 7	[c] 24	.6	12.4	.....
108	69.288	0	.0	2	Nov. 12	15	.5	12.0	.....
109	154,285	0	.0	4	[b] Nov. 14	[c] 14	.5	12.4	.....
110	85,542	0	.0	4	[b] Nov. 22	[c] 19	.6	14.4	.....
111	35,346	0	.0	2	[b] Nov. 22	[c] 15	1.0	14.8	.....

[a] Except where the entire cargo was heating or hot.
[b] Date of loading given is the sailing date.
[c] Days from sailing to discharge.

TABLE II.—*American corn certificated as "No. 2 Corn," "No. 2 Corn, Sail Grade," or "Prime (Sail) Mixed Corn" examined in Europe from November, 1906, to May, 1907, inclusive, showing the quantity found heating or hot, etc.*—Continued.

Cargo.	Quantity examined.	Quantity found heating or hot.		Holds occupied.	Date of loading.	Days in boat.	Dirt and foreign matter.	Moisture in cool corn.[a]	Moisture in heating corn.
No.	*Bushels.*	*Bushels.*	*Per cent.*	*No.*	*1906.*	*No.*	*Per cent.*	*Per cent.*	*Per cent.*
112	17,142	0	0.0	1	Nov. 22	44	.4	12.6	.....
113	69,087	0	.0	3	Nov. 24	17	1.0	14.5	.....
114	17,142	0	.0	1	Nov. 30	29	.4	14.9	.....
115	41,647	0	.0	2	Dec. 4	23	1.5	14.3	.....
116	154,285	1,568	1.0	5	Dec. 5	17	2.3	19.2	.....
117	42,846	0	.0	1	Dec. 5	[b]32	1.5	14.4	.....
118	29,714	0	.0	2	Dec. 7	32	.6	16.6	.....
119	35,849	0	.0	1	Dec. 12	15	1.0	14.9	.....
120	34,285	0	.0	2	Dec. 12	[b]23	2.6	14.8	.....
121	42,857	0	.0	1	Dec. 13	23	.3	16.3	.....
122	71,345	0	.0	4	Dec. 17	14	.5	15.1	.....
123	22,000	[c]2,600	11.8	1	[d] Dec. 17	[e]18	1.2	14.3	22.4
124	30,267	[f]600	2.0	1	[d] Dec. 18	[e]20	1.6	15.1	.....
125	21,600	0	.0	1	[d] Dec. 21	[e]15	.9	14.6	.....
126	60,000	0	.0	2	Dec. 28	58	1.4	14.1	.....
127	18,928	[g]12,000	63.4	1	Dec. 29	42	1.5	14.9	.....
128	17,142	[c]4,200	24.5	2	Dec. 31	56	1.3	16.7	.....
					1907.				
129	34,627	0	.0	2	Jan. 1	24	1.1	16.2	.....
130	60,000	0	.0	2	Jan. 3	19	.7	19.3	.....
131	102,856	[h]4,000	3.9	3	Jan. 3	33	.9	18.4	.....
132	34,285	[c](Slight.)	.0	2	Jan. 8	27	.3	18.8	.....
133	25,720	[c]25,720	100.0	1	Jan. 8	45	.4	14.0	[f]18.6
134	77,142	[g]1,240	1.6	5	Jan. 9	17	.8	19.4	.....
135	218,219	[i]110,431	50.6	5	Jan. 11	37	.6	16.2	.....
136	106,785	[k]88,000	75.2	4	Jan. 15	33	1.2	16.4	.....
137	114,621	0	.0	3	Jan. 21	19	2.7	19.0	.....
138	10,353	[c]511	4.9	1	Jan. 23	17	.4	17.7	.....
139	94,285	[i]11,600	12.3	3	Jan. 23	38	3.4	16.8	.....
140	17,142	0	.0	1	Jan. 24	30	2.3	19.2	.....
141	41,000	0	.0	1	Jan. 25	24	2.2	19.2	.....
142	67,541	[l]300	.4	3	Jan. 28	18	1.3	18.8	19.1
143	156,857	[i]3,802	2.4	4	Feb. 15	31	62.5	19.7	.....
144	85,714	[g]16,000	18.7	2	Feb. 19	36	2.2	16.7	.....
145	192,491	[l]3,066	1.6	5	Feb. 20	20	1.8	19.4	.....
146	180,520	[h]2,700	1.5	5	Feb. 21	25	.4	19.5	.....
147	119,280	0	.0	4	Feb. 23	18	1.8	20.0	.....
148	51,338	[h](Slight.)	.0	3	Feb. 23	20	2.1	19.9	.....
149	25,714	0	.0	1	Feb. 23	24	3.2	18.5	.....
150	197,146	[m]17,425	8.7	5	Feb. 23	21	2.6	19.9	21.1
151	111,428	[g]111,428	100.0	4	[d] Feb. 25	51	1.6	19.6	.....
152	68,571	0	.0	3	Feb. 26	26	.8	17.3	.....
153	68,570	[g]55,428	80.8	3	Feb. 27	27	1.5	16.6	.....
154	208,062	[g]59,000	28.4	5	Feb. 27	34	1.5	17.4	18.0
155	25,714	0	.0	2	Feb. 28	[e]23	.8	19.2	.....
156	197,143	[c]175	.1	6	Mar. 6	20	1.3	18.7	.....
157	34,285	[c]2,000	5.8	1	[d] Mar. 8	[e]19	.6	20.6	.....
158	33,000	[g]20,000	60.6	1	[d] Mar. 10	[e]29	1.6	16.0	.....
159	223,660	[m]15,132	6.8	4	Mar. 11	29	1.9	19.7	23.0
160	157,308	[k]33,854	21.5	5	Mar. 12	30	3.7	16.0	.....
161	25,714	[g]25,714	100.0	1	Mar. 16	20	2.0	15.6	.....
162	17,142	0	.0	1	Mar. 16	25	.2	19.7	.....
163	94,285	0	.0	3	Mar. 16	25	.7	19.0	.....
164	148,100	[k]16,300	11.0	5	Mar. 20	22	1.4	19.4	22.0
165	25,714	0	.0	1	Mar. 20	24	.8	18.7	.....
166	17,142	0	.0	1	Mar. 20	24	.2	19.3	.....
167	42,285	[g]42,285	100.0	2	Mar. 21	41	.....	18.4	.....
168	60,000	[k]12,000	20.0	3	Mar. 25	30	1.5	14.0	.....
169	85,563	[k]13,200	15.4	3	Mar. 25	30	.5	14.5	.....
170	44,640	[g]44,640	100.0	2	Mar. 27	35	1.5	15.6	.....
171	111,428	0	.0	4	Mar. 27	20	1.5	16.7	.....
172	41,800	[k]18,000	43.1	1	[d] Mar. 29	25	.7	14.8	.....

[a] Except when entire cargo was heating or hot.
[b] Days from loading to arrival.
[c] Near propeller-shaft tunnel only.
[d] Date of loading given is the sailing date.
[e] Days from sailing to discharge.
[f] Near shifting boards in one hold.
[g] In all places of stowage.
[h] Near engine or boiler room bulkhead only.
[i] General; but worse near engine and boiler room bulkheads.
[j] These figures show the percentage of moisture found in the more severely damaged portions of the cargo.
[k] Principally in upper portions of grain in all holds.
[l] Near engine or boiler room bulkhead, and near shifting boards in one hold.
[m] At top of some holds, but principally near engine and boiler room bulkheads.

TABLE II.—*American corn certificated as "No. 2 Corn," "No.2 Corn, Sail Grade," or "Prime (Sail) Mixed Corn" examined in Europe from November, 1906, to May, 1907, inclusive, showing the quantity found heating or hot, etc.*—Continued.

Cargo.	Quantity examined.	Quantity found heating or hot.		Holds occupied.	Date of loading.	Days in boat.	Dirt and foreign matter.	Moisture in cool corn. [a]	Moisture in heating corn.
No.	*Bushels.*	*Bushels.*	*Per cent.*	*No.*	*1907.*	*No.*	*Per cent.*	*Per cent.*	*Per cent.*
173	30,739	0	0.0	2	Apr. 1	29	2.1	14.2	.....
174	81,427	0	.0	4	Apr. 2	21	.4	18.7	.....
175	85,713	0	.0	3	Apr. 4	20	.5	15.1	.....
176	102,856	[b] (Slight.)	.0	3	Apr. 10	26	2.8	15.5	.....
177	145,713	0	.0	4	Apr. 11	20	4.3	15.8	.....
178	111,427	[c] 4,000	3.6	4	Apr. 12	24	3.6	16.2	.....
179	30,000	[c] 30,000	100.0	1	Apr. 13	24	2.3	17.7	.....
180	34,284	[b] (Slight.)	.0	2	Apr. 15	29	.5	19.2	.....
181	78,542	[b] 3,375	4.3	3	Apr. 17	21	2.7	17.6	.....
182	103,357	[b] 71,023	68.7	2	Apr. 24	28	1.4	18.3	19.8
183	59,999	[c] 42,857	71.4	2	Apr. 29	16	1.5	17.9	.....
184	115,711	[b] 7,050	6.1	4	Apr. 30	25	2.0	14.3	.....
185	17,142	[b] 9,000	52.5	1	Apr. 30	22	3.4	16.9	.....
186	182,143	[d] 100,608	55.3	4	May 4	19	2.9	17.3	22.3
187	110,322	[c] 55,368	50.2	2	May 8	21	2.7	17.3	19.2
188	102,932	[c] 22,700	22.1	4	[e] May 9	[f] 22	3.6	17.0	.....
	6,598,351	1,120,900	17.0	226	.....	.....	.....	.....	.....

[a] Except when entire cargo was heating or hot.
[b] Principally in upper portions of grain in all holds.
[c] In all places of stowage.
[d] General, but worse near engine and boiler room bulkheads.
[e] Date of loading given is the sailing date.
[f] Days from sailing to discharge.

Figures 2 and 3 illustrate the data contained in Table II and corroborate figure 1 in showing the tendency in corn containing high percentages of moisture to heat and "go out of condition" in ocean transit.

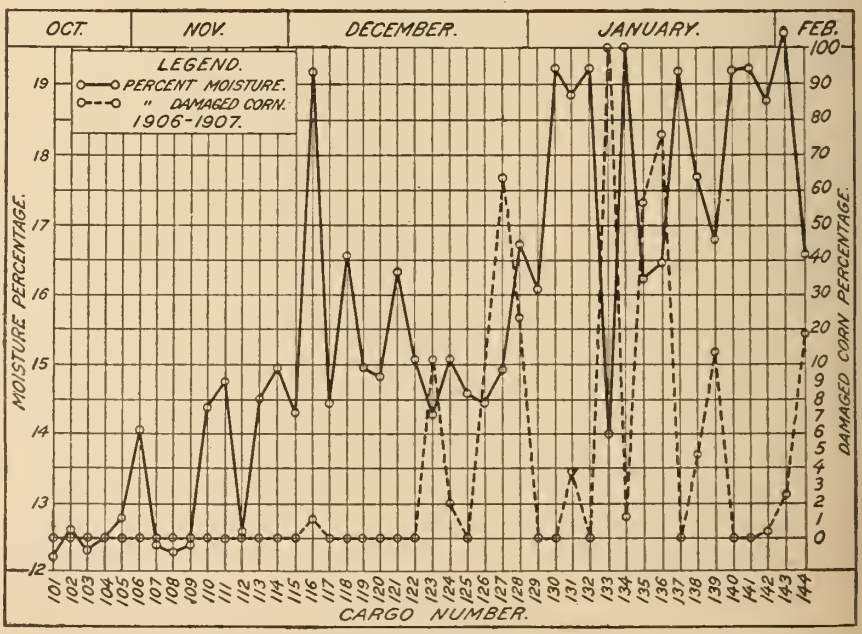

FIG. 2.—Diagram showing in chronological order the cargo number of each shipment, the months during which shipments were made, the percentages of moisture in the corn, and the percentages of corn found damaged in each cargo on arrival in Europe during the fore part of the season of 1906–7.

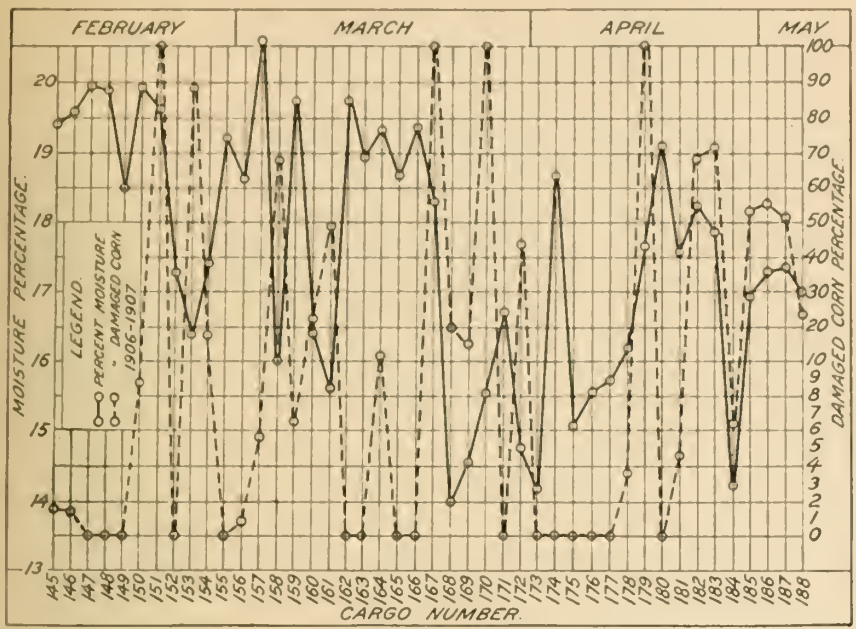

FIG. 3.—Diagram showing in chronological order the cargo number of each shipment, the months during which shipments were made, the percentages of moisture in the corn, and the percentages of corn found damaged in each cargo on arrival in Europe during the remainder of the season of 1906–7.

AMERICAN CORN CERTIFICATED AS "NO. 2 CORN," "NO. 2 CORN, SAIL GRADE," OR "PRIME (SAIL) MIXED CORN" EXAMINED IN EUROPE DURING JANUARY, FEBRUARY, MARCH, APRIL, AND MAY, 1908.

Table III shows in detail the results of the personal examination of fifty-three cargoes of American corn on their arrival at European ports during the months from December, 1907, to May, 1908, inclusive. The fifty-three cargoes contained an aggregate of 4,124,955 bushels, of which 264,282 bushels, or 6.4 per cent, were found to be in a heating or hot condition.

The corn was loaded in the United States on various dates from December 17, 1907, to May 1, 1908. The corn in twenty-four cargoes arrived in an entirely cool condition throughout, while that in twenty-nine cargoes was found to be more or less heating or hot, 100 per cent heating or hot being reached in only one case.

The moisture content of the cool corn in the cargoes varied from 14 to 20 per cent. The dirt and foreign material varied from 0.3 of 1 per cent to 12.3 per cent. Of the total of 264,282 bushels found to be heating or hot during the period, 177,170 bushels, or 67 per cent, were located in the holds of the ships next to the engine and boiler rooms or over the propeller-shaft tunnels. The remaining 86,802

bushels, or 32.9 per cent, of the damaged corn were so located as not to be affected by the heat radiated from the engines and boilers of the ships.

TABLE III.—*American corn certificated as "No. 2 Corn," "No. 2 Corn, Sail Grade," or "Prime (Sail) Mixed Corn" examined in Europe during January, February, March, April, and May, 1908, showing the quantity found heating or hot, etc.*

Cargo.	Quantity examined.	Quantity found heating or hot.		Holds occupied.	Date of loading.	Days in boat.	Dirt and foreign matter.	Moisture in cool corn.[a]	Moisture in heating corn.
No.	*Bushels.*	*Bushels.*	*Per cent.*	*No.*	*1907.*	*No.*	*Per cent.*	*Per cent.*	*Per cent.*
201	18,060	0	0.0	1	Dec. 17	28	2.4	15.0	.....
202	47,142	0	.0	1	Dec. 19	26	.7	14.2	.....
203	88,284	0	.0	3	Dec. 21	24	2.1	16.0	.....
204	121,143	[b] 360	.2	4	Dec. 24	23	.3	17.2	.....
205	68,154	[c] 8,900	13.1	4	Dec. 24	45	1.4	16.9	.....
206	15,867	0	.0	1	Dec. 24	23	2.0	15.6	.....
207	42,857	[c] 900	2.1	2	Dec. 26	44	.4	16.7	28.0
					1908.				
208	42,857	[d] 900	2.1	2	Jan. 1	26	1.5	16.4	16.5
209	34,285	0	.0	1	Jan. 2	27	.9	16.6	.....
210	38,571	0	.0	1	Jan. 3	28	.9	18.4	.....
211	25,714	0	.0	1	Jan. 4	27	1.1	17.8	.....
212	149,525	[c] 2,200	1.5	4	Jan. 6	29	1.0	19.1	25.2
213	18,452	0	.0	2	Jan. 11	35	.5	15.8	.....
214	29,999	0	.0	2	Jan. 16	19	.5	18.7	.....
215	60,000	[c] 51,500	85.8	2	Jan. 17	46	1.2	18.6	.....
216	265,704	[f] 500	.2	6	Jan. 21	21	1.4	18.3	.....
217	161,037	[f] 28,900	18.0	4	Jan. 24	25	4.0	19.5	26.5
218	138,206	[b] 400	.3	3	Jan. 27	21	2.4	19.1	24.4
219	131,141	0	.0	3	Jan. 29	22	.9	18.6	.....
220	75,857	[c] 100	.1	1	Jan. 30	21	.6	19.6	.....
221	262,462	[f] 11,400	4.3	5	Feb. 3	23	2.0	20.0	25.3
222	104,000	0	.0	2	Feb. 4	23	1.4	17.1	.....
223	100,325	0	.0	3	Feb. 5	23	.7	17.2	.....
224	65,484	[g] 8,000	12.2	1	Feb. 5	23	.4	19.3	.....
225	54,044	[b] 1,700	3.1	3	Feb. 8	20	.9	18.5	.....
226	156,854	[c] 50,000	31.9	4	Feb. 10	36	1.2	18.9	23.2
227	60,010	0	.0	3	Feb. 11	24	2.2	17.7	.....
228	8,571	0	.0	1	Feb. 11	24	.3	19.6	.....
229	102,400	[c] 2,000	2.0	5	Feb. 12	35	.9	15.3	15.0
230	155,564	[c] 16,000	10.3	4	Feb. 13	22	3.3	17.8	18.5
231	85,714	[b] 8,600	10.0	2	Feb. 13	32	1.7	16.0	20.4
232	102,857	0	.0	4	Feb. 17	19	.8	17.0	.....
233	154,282	[b g] 2,228	1.4	6	Feb. 20	23	1.0	20.0	21.8
234	68,570	0	.0	3	Feb. 27	21	2.6	17.3	.....
235	51,428	0	.0	2	Mar. 19	18	2.2	18.4	.....
236	102,857	1,000	1.0	4	Mar. 21	25	3.1	18.3	.....
237	12,857	[g] 200	1.6	1	Mar. 27	28	.8	17.2	.....
238	145,714	0	.0	4	Mar. 5	29	.6	16.2	.....
239	8,530	0	.0	1	Mar. 5	55	.9	14.0	.....
240	60,107	0	.0	2	Mar. 7	27	3.0	16.9	.....
241	42,857	[b] 50	.1	1	Mar. 11	20	1.6	16.4	.....
242	42,437	[e] 11,280	26.6	2	Mar. 12	45	1.9	16.2	.....
243	94,182	0	.0	3	Mar. 20	21	.9	15.8	.....
244	47,142	0	.0	2	Mar. 27	28	3.4	16.9	.....
245	17,142	[c] 1,000	5.8	1	Mar. 27	28	1.9	18.0	.....
246	68,571	[g] 600	.9	3	Mar. 28	26	.9	17.6	.....
247	77,142	[b g] 1,680	2.2	3	Apr. 6	24	1.5	15.9	16.6
248	81,428	[c] 800	1.0	3	Apr. 13	27	.7	16.7	.....
249	107,142	[d] 1,400	1.3	5	Apr. 16	23	3.1	16.6	.....
250	25,714	0	.0	1	Apr. 22	21	12.3	15.8	.....
251	34,285	[e] 34,284	100.0	3	Apr. 25	21	8.1	15.8	.....
252	25,714	[e] 17,500	68.1	1	Apr. 30	30	2.8	17.1	18.2
253	25,714	[b] (Slight.)	.0	1	May 1	28	5.9	15.6	.....
	4,124,955	264,282	6.4	137	.....	.....	.....	.....	.....

[a] Except where the entire cargo was heating or hot.
[b] Principally in upper portions of grain in all holds.
[c] Near engine or boiler room bulkhead only.
[d] Near engine or boiler room bulkhead, and near shifting boards in one hold.
[e] General, but worse near engine and boiler room bulkheads.
[f] At top of some holds, but principally near engine and boiler room bulkheads.
[g] Near propeller-shaft tunnel only.

Figure 4 illustrates the data contained in Table III with regard to the moisture content of the corn and the quantities of corn found heating or hot in the different shipments.

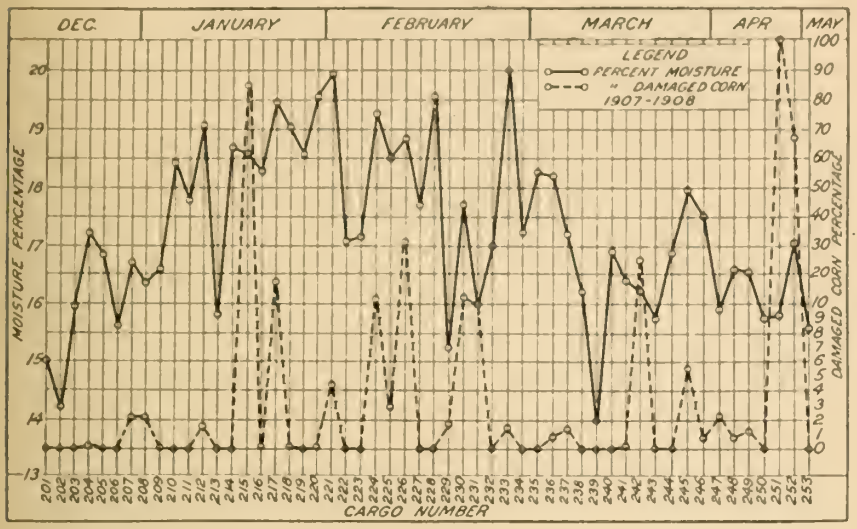

FIG. 4.—Diagram showing in chronological order the cargo number of each shipment, the months during which shipments were made, the percentages of moisture in the corn, and the percentages of corn found damaged in each cargo on arrival in Europe during the season of 1907–8.

SUMMARY OF THE THREE SEASONS' WORK.

Table IV is a summarized statement of the foregoing tables showing the quantities of corn examined and the quantities and percentages found heating or hot during the three seasons of 1905–6, 1906–7, and 1907–8.

TABLE IV.—*American "No. 2 Corn," "No. 2 Corn, Sail Grade," or "Prime (Sail Mixed Corn" examined on arrival at European ports during 1905–6, 1906–7, and 1907–8, showing the quantity found heating or hot.*

Year.	Quantity examined.	Quantity found heating or hot on arrival.	
	Bushels.	*Bushels.*	*Per cent.*
1905–6	4,354,681	526,192	12.1
1906–7	6,598,351	1,120,900	17.0
1907–8	4,124,955	264,282	6.4
	15,077,987	1,911,374	12.7

THE EFFECT OF STOWAGE ON CORN EXAMINED DURING THE SEASON OF 1907–8.

Table V shows the influence of stowage in the ships toward causing damage in transit to the corn examined on arrival in Europe during the season of 1907–8.

TABLE V.—*The effect of stowage on corn examined during the season of 1907–8.*

Location of heating or hot corn.				Total corn found heating or hot.	Sea-damaged corn.	
In holds adjacent to engine and boiler room bulkheads and shaft tunnels.		In holds not adjacent to engine and boiler room bulkheads and shaft tunnels.				
Bushels.	*Per cent.*	*Bushels.*	*Per cent.*	*Bushels.*	*Bushels.*	*Per cent.*
177,170	67.0	86,802	32.9	263,972	310	0.1

COMPARISON OF THE MONTHS IN WHICH THE CORN WAS SHIPPED AND THE QUANTITIES FOUND HEATING OR HOT ON ARRIVAL.

Table VI shows the quantities of corn examined and the quantities found heating or hot, arranged according to the months during which the shipments were made. From this table it will be seen that considerable quantities of the corn shipped during the winter months, as well as that shipped during the spring months, or during the so-called "germinating season," arrived in a heating or hot condition. The highest percentage of heating or hot corn was found in the shipments made during May. The next highest percentage was found in the corn shipped during April, while the percentage found heating or hot in that shipped during March was less than was found in the shipments made during either January or February. The corn examined which was loaded during October and November was to all appearances "old crop" corn containing low percentages of moisture, none of which was found "out of condition" or heating.

TABLE VI.—*Comparison of the months in which the corn was shipped and the percentages found heating or hot on arrival.*

Month.	1905–6.			1906–7.			1907–8.			Total.		
	Cargoes. (a)	Quantity examined.	Proportion found heating or hot.	Cargoes. (a)	Quantity examined.	Proportion found heating or hot.	Cargoes. (a)	Quantity examined.	Proportion found heating or hot.	Cargoes. (a)	Quantity examined.	Proportion found heating or hot.
		Bushels.	*P. ct.*		*Bushels.*	*P. ct.*		*Bushels.*	*P. ct.*		*Bushels.*	*P. ct.*
October	.....	.....	.....	5	198,480	0.0	.....	.....	.....	5	198,480	0.0
November	.....	.....	.....	9	529,609	.0	.....	.....	.....	9	529,609	.0
December	2	149,999	3.6	14	622,765	3.4	7	401,507	2.5	23	1,174,271	3.1
January	11	1,751,935	7.6	14	1,004,576	24.1	13	1,171,348	7.2	38	3,927,859	11.7
February	3	402,129	22.6	13	1,491,405	18.0	14	1,481,137	6.8	30	3,374,671	13.6
March	5	702,632	.5	17	1,359,209	17.9	12	693,824	2.0	34	2,755,665	9.5
April	11	1,296,434	20.6	13	996,910	16.8	6	351,425	15.8	30	2,644,769	18.6
May	2	51,552	49.9	3	395,397	45.2	1	25,714	.0	6	472,663	42.3

(a) The number of cargoes examined during the month in each case is shown.

COMPARISON OF THE LENGTH OF TIME THE CORN WAS IN THE VESSELS AND THE QUANTITIES FOUND HEATING OR HOT ON ARRIVAL.

Table VII shows the length of time the corn examined was in the vessels and the quantities found in a heating or hot condition. The table is arranged in periods of 10 days each, with the exceptions of the first and last periods which are from 13 to 15 days, inclusive, and from 56 to 58 days, inclusive, respectively. It will be seen in the totals of this table that of the corn examined during the three years the percentage that was found heating or hot increased directly (with but one exception, which is explained) as the length of time in the ships increased. The percentages of damage vary from 3.5 per cent in the first period to 42.5 per cent for the period from 46 to 55 days.

TABLE VII.—*Comparison of the length of time the corn was in the vessels and the quantities found heating or hot on arrival.*

Year.	Number of days in boat: 13 to 15.			16 to 25.			26 to 35.		
	Quantity examined.	Quantity found heating or hot.		Quantity examined.	Quantity found heating or hot.		Quantity examined.	Quantity found heating or hot.	
	Bushels.	*Bushels.*	*P. ct.*	*Bushels.*	*Bushels.*	*P. ct.*	*Bushels.*	*Bushels.*	*P. ct.*
1905–6	510,504	29,948	5.9	1,480,404	188,470	12.7	2,179,429	302,719	13.9
1906–7	[a] 351,864	0	.0	3,635,038	341,443	9.4	1,796,808	445,793	24.8
1907–8	0	0	.0	2,699,044	107,902	4.0	1,047,109	33,800	3.2
	862,368	29,948	3.5	7,814,516	637,545	8.2	5,023,346	782,312	15.6

Year.	Number of days in boat: 36 to 45.			46 to 55.			56 to 58.		
	Quantity examined.	Quantity found heating or hot.		Quantity examined.	Quantity found heating or hot.		Quantity examined.	Quantity found heating or hot.	
	Bushels.	*Bushels.*	*P. ct.*	*Bushels.*	*Bushels.*	*P. ct.*	*Bushels.*	*Bushels.*	*P. ct.*
1905–6	0	0	0.0	[b] 184,284	5,385	2.9	0	0	0.0
1906–7	593,827	218,036	36.7	143,672	111,428	77.6	[c] 77,442	4,200	5.4
1907–8	310,302	71,080	22.9	168,530	51,500	75.3	0	0	.0
	904,129	289,116	32.0	396,486	168,313	42.5	77,442	4,200	5.4

[a] Average moisture of this corn 13.3 per cent; range 12 to 15.1 per cent.
[b] Average moisture of this corn 15.7 per cent; range 15 to 16 per cent.
[c] Two cargoes only, containing 14.6 and 16.7 per cent moisture; the former contained no heating or hot corn.
See cargoes Nos. 126 and 128 in Table II.

COMPARISON OF THE PERCENTAGES OF MOISTURE IN THE CORN AND THE QUANTITIES OF CORN FOUND HEATING OR HOT ON ARRIVAL.

Table VIII shows the corn examined arranged in divisions of 2 per cent of moisture, from 12 to 14 per cent, 14.1 to 16 per cent, and 16.1 to 18 per cent, and a division of from 18.1 per cent to 20.6 per cent moisture, respectively, and the quantity found heating or hot in each division.

In this table it will be seen that the percentage of corn found heating or hot on arrival increased with but few exceptions as the moisture content increased. The exceptions being almost wholly due to most favorable shipping conditions, which materially reduced the percentage of damage in the corn containing from 18.1 to 20.6 per cent of moisture.

TABLE VIII.—*Comparison of the percentages of moisture in the corn and the percentages of corn found heating or hot on arrival in Europe.*

Moisture content.[a]	1905–6.		1906–7.		1907–8.		Total.	
	Quantity examined.	Proportion found heating or hot.	Quantity examined.	Proportion found heating or hot.	Quantity examined.	Proportion found heating or hot.	Quantity examined.	Proportion found heating or hot.
Per cent.	*Bushels.*[b]	*P. ct.*	*Bushels.*	*P. ct.*	*Bushels.*	*P. ct.*	*Bushels.*	*P. ct.*
12 to 14	.....	.....	563,835	[c]6.7	8,530	0.0	572,365	6.6
14.1 to 16	505,542	1.4	1,340,090	10.7	735,813	6.3	2,581,445	7.7
16.1 to 18	3,034,205	8.3	1,946,142	33.2	1,474,590	4.1	6,454,937	14.9
18.1 to 20.6	763,382	31.5	2,748,184	10.6	1,906,022	8.2	5,417,588	12.8

[a] According to tests made of the cool corn in each cargo, except in cases where all the corn was heating or hot.
[b] Except cargoes Nos. 33 and 34.
[c] This corn contained 14 per cent of moisture and was only slightly heating and not discolored, a condition known in Europe as "dry heat."

COMPARISON OF THE MOISTURE CONTENT OF THE CORN AND THE NUMBER OF CARGOES CONTAINING HEATING OR HOT CORN ON ARRIVAL.

Table IX shows the number of cargoes examined and found to contain heating or hot corn on arrival arranged according to different percentages of moisture and the percentage of the cargoes found to contain heating or hot corn.

TABLE IX.—*Comparison of the moisture content of the corn and the number and percentage of cargoes containing heating or hot corn on arrival.*

Year.	Cargoes examined.[a]	Range of moisture content (cool corn).											
		12 to 14 per cent.			14.1 to 16 per cent.			16.1 to 18 per cent.			18.1 to 20.6 per cent.		
		Cargoes examined.	Cargoes containing heating or hot corn.		Cargoes examined.	Cargoes containing heating or hot corn.		Cargoes examined.	Cargoes containing heating or hot corn.		Cargoes examined.	Cargoes containing heating or hot corn.	
	No.	*No.*	*No.*	*P. ct.*	*No.*	*No.*	*P. ct.*	*No.*	*No.*	*P. ct.*	*No.*	*No.*	*P. ct.*
1905–6	32	0	0	0.0	5	3	60.0	20	17	85.0	7	7	100.0
1906–7	88	11	2	18.2	25	9	36.0	22	17	77.3	30	[b]15	50.0
1907–8	53	1	0	.0	13	4	30.8	22	13	59.1	17	[b]12	70.6
	173	12	2	16.7	43	16	37.2	64	47	73.4	54	34	63.0

[a] Except cargoes Nos. 33 and 34.
[b] Winter shipments from northern ports in most cases.

THE CORN EXAMINED IN EUROPE GRADED ACCORDING TO GRADE MOISTURE LIMITS OF THE GRAIN DEALERS' NATIONAL ASSOCIATION.

The Grain Dealers' National Association at its annual convention held at St. Louis, Mo., in October, 1908, adopted rules and specifications for commercial grain grades and recommended that they be adopted for general use in the grain business. These rules limited the percentages of moisture to be allowed in the different grades of corn as follows: "No. 1 Corn," 15 per cent; "No. 2 Corn," 16 per cent; "No. 3 Corn," 19 per cent; and "No. 4 Corn," 22 per cent, these grades to include cool corn only.

Table X shows the corn examined arranged in grades according to its moisture content as tested in Europe and according to the limits of moisture fixed for each grade by the association rules. From this table it will be seen that according to those rules 2,815,795 bushels, or 18.7 per cent, of the corn examined and that was shipped as "No. 2" or equivalent grades would have been graded "No. 2" or better; that 7,528,941 bushels, or 50.1 per cent, would have been graded "No. 3;" that 2,796,058 bushels, or 18.6 per cent, would have been graded "No. 4;" and that 1,885,641 bushels, or 12.7 per cent, would have been graded "Sample," on account of being heating or hot. Had the heating or hot corn in the shipments arrived cool it would have been classed among the other grades, as in that case it is believed none of the corn would have shown moisture contents of more than 20.6 per cent, the highest percentage of moisture found in any of the cool corn.

TABLE X.—*American corn certificated as "No. 2" or equivalent grades examined in Europe[a] arranged in grades according to the moisture limits of the rules adopted by the Grain Dealers' National Association at St. Louis, Mo., in October, 1908.*

Grade.	Moisture limit.	1905–6.			1906–7.			1907–8.			Total.		
		Cargoes.[b]	Quantity examined.		Cargoes.[b]	Quantity examined.		Cargoes.[b]	Quantity examined.		Cargoes.[b]	Quantity examined.	
	P. ct.	*No.*	*Bushels.*	*P. ct.*	*No.*	*Bushels.*	*P. ct.*	*No.*	*Bushels.*	*P. ct.*	*No.*	*Bushels.*	*P. ct.*
Number 1	15	3	353,758	8.2	28	1,274,207	19.3	3	73,732	1.8	34	1,701,697	11.3
Number 2	16	2	144,614	3.4	8	348,294	6.8	10	521,190	12.6	20	1,114,098	7.4
Number 3	19	25	3,260,352	76.0	32	1,956,034	29.6	32	2,303,555	55.9	89	7,528,941	50.1
Number 4	22	2	34,946	.8	20	1,798,916	27.3	8	962,196	23.3	30	2,796,058	18.6
Sample[c]		27	500,459	11.6	43	1,120,900	17.0	28	264,282	6.4	98	1,885,641	12.6

[a] Cargoes Nos. 33 and 34 not included.
[b] The number of cargoes in which the different grades were represented.
[c] Includes only corn found heating or hot.

ARTIFICIALLY DRIED CORN.

Several cargoes that had been shipped as "artificially dried" corn were examined. This corn was certificated as No. 2 or equivalent grades and the data relating thereto are included in the tables and diagrams. Various terms in addition to the grades were used in

the certificates of inspection accompanying these shipments to indicate that the corn had been artificially dried. During the season 1907–8, 1,299,075 bushels of such corn were examined on arrival and 54,314 bushels, or 4.1 per cent, were found to be in a heating condition.

None of this so-called "dried" corn which arrived cool showed a moisture content of less than 15.2 per cent, while some of the cool corn contained as high as 19.4 per cent of moisture, and the corn found heating in the various cargoes was quite evenly distributed from that containing the lowest to that containing the highest percentage of moisture, showing that the partial drying of corn containing high percentages of moisture so disturbs conditions as to cause it to be generally unsafe for ocean shipment.

THE GRADES OF "STEAMER" AND "NO. 3 CORN."

Aside from the better grades of corn heretofore considered considerable quantities of the lower grades of "Steamer" and "No. 3 Corn" were examined, but the data relating thereto are not included in the tables or diagrams.

Of this corn 51,428 bushels in two cargoes, which were loaded and shipped in January and February, 1908, and the voyages of which consumed 17 and 20 days, respectively, showed a moisture content ranging from 19.2 to 22.5 per cent, an average of 19.8 per cent. The corn was stowed in holds free and away from boiler or engine room heat, and no heating or hot corn was found in either cargo.

HEAT-DAMAGED CORN ARTIFICIALLY DRIED.

Several shipments or parcels, amounting in all to 79,847 bushels of badly discolored heat-damaged corn, sometimes known as "mahogany," which had been artificially dried before shipping, were also examined in Europe. These shipments bore certificates as "rejected corn," "dried," and the data relating thereto are not included in the tables and diagrams. The moisture content of this corn varied from 13.2 to 17.4 per cent. Such corn is used almost entirely for distilling purposes on the continent of Europe.

EXPORT CARGOES OF WHEAT.

Several cargoes of wheat which were exported from the Atlantic and Gulf ports of the United States were also examined on arrival in Europe, and many complaints, some of which were verified, accompanied by samples and data, were submitted to the writers. These complaints were largely centered about shipments of hard winter wheat from the Gulf ports, which were, in some cases, received in Europe in a badly heating and damaged condition, due to an excess

amount of moisture in the grain at the time of shipment. In other cases the cargoes arrived cool, but the wheat contained large percentages of damaged kernels caused by the wheat having been heated before shipment.

Other complaints of American wheat shipments brought to the notice of the writers had relation to the relatively poor quality and dirty condition of deliveries of No. 1 Northern Spring wheat; to deliveries of semihard wheat, mixtures of soft and hard wheats, and entirely soft red winter wheats upon hard winter wheat purchases; to deliveries of damp, smutty, and heat-damaged durum wheat upon purchases of No. 1, No. 2, and No. 3 Durum wheat; and to deliveries of wheat containing considerable quantities of wild garlic on purchases of No. 2 Soft Red Winter wheat.

OBSERVATIONS AND RECOMMENDATIONS.

FACTORS AFFECTING GENERAL CONDITIONS.

THE MOISTURE CONTENT OF "NO. 2 CORN" AND "MIXED CORN."

The rules and specifications defining the grades of "No. 2 Corn" and "Mixed Corn" (the latter being used almost exclusively by one export market) of both the interior and export grain markets of the United States definitely require that corn of those grades shall be "sound" and "dry," and the addition of the terms "Sail Grade" or "Prime Sail" are used upon the inspection certificates of some export markets to emphasize the factor of dryness, yet the cool corn which bore certificates of those grades and was examined in Europe contained on arrival all the way from 12 to 20.6 per cent moisture.

So far as these investigations have progressed, it is not thought possible under ordinary conditions of ocean transportation for corn or other grain, confined as it is in the holds of the ships, to take on moisture from the air, as wheat from semiarid regions is said to do when otherwise transported to more humid regions, especially when the moisture content of the grain as shipped is high.

HOW CHANGES IN MOISTURE CONTENT MAY TAKE PLACE ON BOARD SHIP.

There are two means by which the moisture content in any part or the whole of a ship's corn cargo may be increased during transit: (1) The transfer of moisture by air currents caused by changes in temperature; and (2) by chemical changes within the corn kernel.

As to the first means, corn containing excessive moisture and situated so the moisture can escape when subjected to heat will give off moisture and become drier. The moisture thus given off in a ship's hold, in case the temperatures in the hold are not uniform, finds its way to the usual air space above the corn and under the

deck, passing thence as water to other parts of the hold, where it condenses on the cooler corn, the cooler deck, and the sides of the ship. This process, augmented as time goes on by the second means, may increase considerably the moisture content of the corn in some portions of the hold or cargo.

The second means by which the moisture content of the corn may be increased is by changes in the chemical composition of the kernel, the effect of which is more evident in corn that is heating badly. Conditions of temperature and moisture may be favorable in some part of a cargo for fermentation to begin and continue with more or less vigor. The heat generated in this process is gradually transmitted to the surrounding portions, starting and increasing fermentation, which decomposes the grain and liberates its water of composition, thus increasing the amount of moisture in some portions or in the whole cargo, if conditions are not disturbed, without any addition whatever of moisture from outside sources.

From these causes the corn in many of the ships examined was found to be damp and heating at the top, while that beneath was cool, and the iron decks and sides of the ships were found to be quite wet with the condensed moisture from the heating corn.

THE "GERMINATING SEASON."

In the grain trade the "germinating season," so called, is understood to be a special season of the year during which grain is customarily planted in the ground. The limits of this season are not very clearly defined, but it is generally understood to extend from about the middle of March to the middle of June. It is generally believed that there is a natural and inherent tendency in grain to germinate during that season, and that the heating of grain in storage and in transit during those months is due primarily to this tendency.

From the nature of the damage usually found in corn in a heating or hot condition in storage or in ships in transit there seems to be good reason for doubting that the germinative processes are responsible for the damage, as such corn does not usually appear to have germinated. Sprouted corn was occasionally found in the cargoes examined, but only at the top of the bulk, where considerable additional moisture had been supplied, either through condensation, as described elsewhere, or from outside sources.

CONDITIONS NECESSARY TO GERMINATION.

In order that corn or any of the grains may germinate there must be present: (1) Air or oxygen; (2) heat; and (3) moisture. If one or more of these are absent germination will not take place, but if all are present at the same time and in sufficient quantities and the

germ of the grain be alive, germination will take place regardless of the time, the place, or the season of the year.

There can be no doubt that the same conditions of temperature and moisture that favor germination or the active growth of the germ of the grain are favorable also to the growth of molds and bacteria, as well as the production and action of certain ferments which have the power of changing the composition of the grain kernels, and which in their action produce heat sufficient to cause the heating of the grain.

There is too little known of the great subject of fermentation in nature to enable more to be said than that some kind of fermentation does frequently take place in bulk grain and that this is the principal danger to which damp grain in storage or in transit is exposed.

SHIPMENTS OF "WINTER-SHELLED" CORN.

In the Northern Hemisphere during the spring months the proper combination of the elements favorable to the production and action of ferments is more likely to exist than during the other seasons of the year. The fact that the corn shipped for export during the early spring months of the past several years has been mostly "winter-shelled" corn, which still retained a relatively large percentage of its moisture and in which fermentation had frequently begun before shipment, and the further fact that much damage has been sustained through the shipment of such corn is what undoubtedly originated and what has perpetuated the idea of a "germinating season."

Corn in which fermentation has begun need not necessarily be hot or even perceptibly heating, but the action is usually indicated by a peculiar faintly sour odor present. The presence of this odor should serve as a warning to the shipper or handler of corn, because corn in which the odor is present soon becomes hot if not frequently and thoroughly ventilated, more especially if its moisture content is high.

THE IMPORTANCE OF MOISTURE CONTENT IN CORN IN OCEAN TRANSIT.

These investigations have led to the conclusion, which is believed to have been clearly demonstrated in the tables and diagrams, that the moisture content of corn, and of other grains as well, is the primary factor determining their capacity to carry safely in ocean transit without deterioration, and the importance of this factor has been emphasized throughout the work. Corn in which the moisture content is sufficiently low will carry safely under ordinary conditions of ocean transit for any reasonable length of time during any season of the year, no matter where it is stowed in the vessel, while corn containing a high moisture content is constantly in danger of heating at any time owing to a variety of contributing causes.

It has been shown that although somewhat drier corn was shipped to Europe during the spring months, its moisture content was still not

sufficiently low in many cases to enable the corn to carry safely at the naturally increased temperatures encountered en route.

Thoroughly air-dried corn contains about 12 per cent of moisture. Such corn may be shipped for export at any time under ordinary conditions with little or no danger from heating in transit, and this is practically true also of corn containing up to 14 per cent of moisture, provided fermentation has not started in such corn.[a]

CONDITIONS NECESSARY FOR SHIPPING DAMP CORN.

The fact that certain lots of corn contain high percentages of moisture does not necessarily mean that they will not stand ocean shipment safely. The voyage may be short, the air temperature at the time of loading and during the voyage may be low, no disturbing influence such as heat radiated from the ship's boilers may be encountered, and the corn kept practically in cold storage. Under such most favorable conditions a high percentage of moisture may often be safely carried in corn. Cargoes of such corn are often landed upon the quays in Europe in a perfectly cool (cold, in fact) condition, which corn upon being exposed to warmer atmospheric conditions soon "goes out of condition" and becomes hot and unfit for reshipment via the waterways of Europe, as is required of much of the grain received abroad.

THE EFFECT OF HIGH AND LOW MOISTURE CONTENTS.

When corn goes out of condition, the effect of its relative moisture content immediately becomes evident. Corn with a low moisture content requires a much longer time to reach that stage designated as "hot" or to become discolored or "damaged" by the process of heating than corn with a high moisture content, while corn with a high moisture content will heat, become discolored, and lose weight by evaporation quickly, and the processes of deterioration are accelerated with each additional per cent of moisture much more rapidly than the proportionate increase in the moisture content.

When corn of a low moisture content is found in a heating condition, it can ordinarily be restored to its original condition with but a slight amount of handling and ventilating and without much, if any, loss in value through discoloration, while corn with a high moisture content, when heating in any considerable bulk, quickly becomes badly discolored and damaged and is with great difficulty and a great amount of handling restored to a cool condition, and then only with more or less damage to its quality and a corresponding loss in value.

[a] None of the corn examined in Europe which contained less than 14 per cent of moisture was found in a heating condition, excepting in cases where moisture had been expelled through the heating processes, regardless of its location in the ships.

THE MOISTURE CONTENT OF CORN FROM ARGENTINA.

With respect to its moisture content, the corn received in Europe from Argentina appears to have an advantage over corn from the United States, notwithstanding that it must cross the equator and the Torrid Zone in transit to Europe. A number of tests of Argentine corn showed moisture contents ranging from 12.2 to 15.5 per cent. The corn with the higher moisture content frequently arrived in a heating condition but was restored to condition, without much or any change from its original appearance and color, with but little handling and ventilating.

THE DIRT AND FOREIGN MATTER IN CORN.

During the process of loading grain into the hold of a ship, the finely broken particles of corn, dirt, and foreign matter tend to collect and remain directly beneath the hatches, the whole kernels shifting and rolling much more readily than the broken particles and dirt. Owing to this tendency large amounts of dirt and finely broken corn were frequently found immediately beneath the hatches of the ships examined, and heating and moldy corn was also frequently found in those localities. The heating processes were undoubtedly aided by these collections of finer matter, especially when found in contact with damp shifting boards or other cargo introduced into the hold in a damp or wet condition.

THE STOWAGE OF EXPORT GRAIN IN SHIPS.

Practically all of the grain that is exported to Europe from the Atlantic and Gulf ports of the United States is carried in bulk, with the exception of small quantities placed in sacks, which is used in trimming cargo in order to prevent the bulk grain from shifting with the rolling and pitching of the ship. When a ship carries a full cargo each hold is, of course, filled or nearly filled with grain, but when grain forms only a portion of the cargo one or more holds are sometimes filled with grain only and the remaining holds contain other freight, while in other cases the grain is distributed along the bottom of the ship, each hold containing about the same depth of grain, in which cases other cargo is stowed on the top of the grain.

THE STOWAGE OF DRY AND DAMP CORN.

When the corn is thoroughly air dried it is not a matter of great importance where or how it is stowed, so long as it does not come into contact with sea water, green or wet shifting boards, or damp or wet freight, such as cotton that has been exposed to rain before being loaded, wet lumber, etc.

Where the shipments of corn contained a percentage of moisture much above that of thoroughly air-dried corn it was found in a large percentage of the holds examined that at least some of the corn was heating, and in some cases that all of it was in that condition.

In many cases the damage was confined to the corn at the top of the cargo, where the grain was loaded under and came in contact with damp cotton, copper, or other heavy or wet freight, and where the corn was located against wet shifting boards or along the sides of the ship, where condensation had taken place, while in other cases the heating grain was apparently protected from boiler heat and had no other freight loaded upon it.

THE HEAT RADIATED FROM THE SHIP'S BOILERS AND ENGINES.

Where the heating occurred, the temperature as well as the degree of damage in the corn was not uniform in the damaged portions. When the damaged corn was located in that section of the ship contiguous to the boiler and engine room bulkheads, to the propeller-shaft tunnels, or in the coal-bunker holds, as it was in the greatest number of cases, the greatest heat and the most severe damage were usually found nearest to those bulkheads and shaft tunnels, and less heat and a less degree of damage the farther the distance from them. The usual situation in such cases is indicated in figure 5.

THE LENGTH OF VOYAGE AND ITS INFLUENCE ON CORN.

The length of voyage of grain steamships from Argentina to Europe averages about thirty-five days, from the American Atlantic ports about thirteen days, and from ports on the Gulf of Mexico about twenty days.

The available information and data regarding the length of voyage of the cargoes examined in Europe seem to warrant the conclusion that if corn when loaded into ships is sound and dry, the length of the voyage has little or no effect upon its condition, but when it is shipped with a high moisture content and is stowed in such a way as to be subjected to heat from the inside of the ship or is shipped during the warm seasons of the year when it is subjected to considerable heat from the outside atmosphere, the length of the voyage is a very important factor, especially if the heating begins early in the voyage, in which case the heat is gradually diffused with each succeeding day and a higher temperature is developed in the corn already heating. Thus with each succeeding day more of the sound corn begins to heat and the corn already heating becomes more severely damaged.

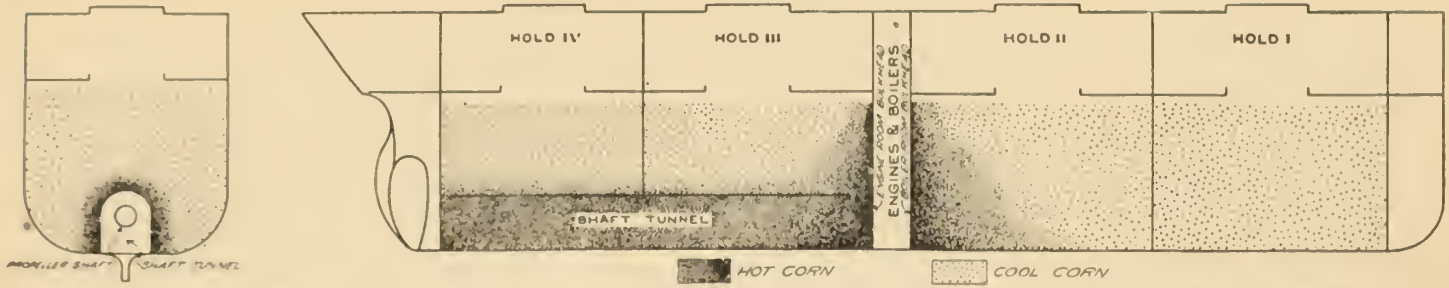

FIG. 5.—Sketch showing the danger to which corn and other grains containing high percentages of moisture are exposed when loaded into ships against unprotected boiler and engine room bulkheads and propeller-shaft tunnels.

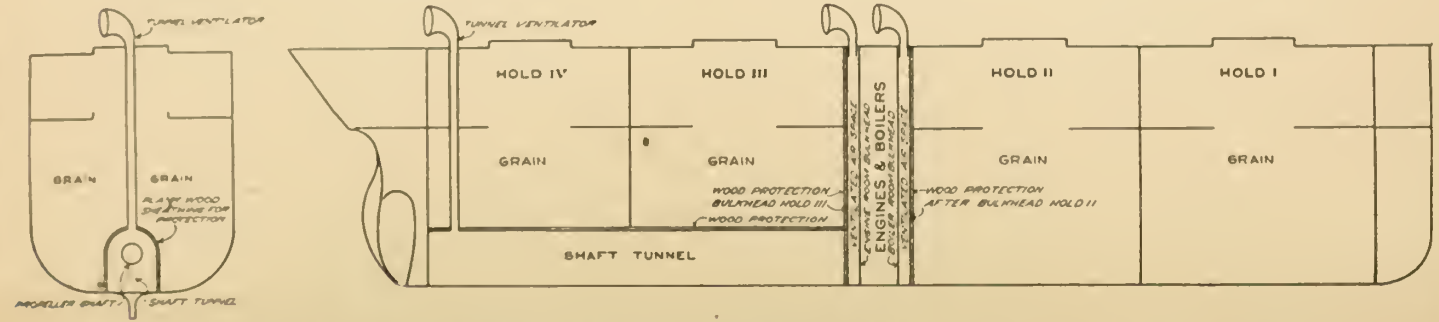

FIG. 6.—Sketch showing a desirable arrangement in grain-carrying ships, the boiler and engine room bulkheads being protected by ventilated air spaces, reenforced with plank sheathing, and the propeller-shaft tunnel plank sheathed and ventilated.

A DESIRABLE ARRANGEMENT IN GRAIN-CARRYING SHIPS.

The danger of grain, and especially corn, going out of condition or heating when loaded against the unprotected boiler and engine room bulkheads and over the unprotected or nonventilated propeller-shaft tunnels of grain-carrying ships has led to the construction in many such ships of second or false bulkheads, so placed as to form air spaces of from 12 to 18 inches between the bulkheads of the cargo holds and those of the engine and boiler rooms, and the installation of ventilators for the propeller-shaft tunnels, the air spaces formed by the false bulkheads being also provided with ventilators extending through the decks on the port and starboard sides of the ships.

This arrangement tends to keep the superheated bulkheads, with which the grain would otherwise come in contact, and the shaft-tunnel coverings in a reasonably cool condition by allowing the heat to escape. Ships arranged in this manner, and especially when the additional bulkheads and the shaft-tunnel coverings are further protected by a plank sheathing next to the cargo, are very desirable ships for carrying grain or any other perishable cargo that may be affected by high temperatures. This arrangement is illustrated in figure 6.

FORMS OF GRAIN CONTRACTS.

In a general way, and so far as they affect the quality of the grain bought or sold, there are four forms of contract upon which grain is purchased in Europe from the United States, as follows: (1) That it be of fair average quality of the season's shipments at the time and place of shipment; (2) that it be equal to a sealed sample (agreed upon) at the time and place of shipment; (3) that an official certificate of inspection be final as to quality; and (4) American rye terms, which last form provides that the seller shall guarantee the condition of the grain on arrival in Europe, "ship or sea" damage excepted, differences arising out of the contract, if any, to be arbitrated in Europe.

ADVANTAGES AND DISADVANTAGES OF CONTRACTS.

By far the greatest portion of the export grain business of the Atlantic and Gulf ports of the United States is done upon the basis of the third contract or "certificate of inspection final" terms, because the American exporter has heretofore generally refused to sell grain for export upon any other terms. On the other hand, the European importer has found this contract advantageous, in that resales in Europe to small dealers and consumers have heretofore been more easily negotiated than was the case with grain bought upon the basis of any of the other contracts.

Under the terms of the third contract the purchaser has no recourse other than to accept the American inspection certificate as repre-

senting the quality of grain purchased and to assume all risks of deterioration in transit. Therefore, the greater portion of the corn exported is purchased as "No. 2 Corn" and "Mixed Corn," because those grades are presumed to be of a quality that may be expected to carry in transit with reasonable safety from deterioration. The lower grades are very little dealt in, principally because of the presumably greater risk from deterioration in transit.

The sale of grain upon any of the other contracts than that of the "inspection certificate final" terms places the American exporter at a disadvantage, because by their terms all differences are required to be arbitrated in Europe. They also place the European importer at a disadvantage because, first, he is necessarily obliged to purchase at a higher price to cover the added risk assumed by the exporter, and, second, unless the purchase is made for his own use or consumption it involves reselling in Europe at a relatively higher price upon samples or special representations as to the quality of the grain, a process which makes the marketing of the grain cumbersome and undesirable from the standpoint of grain-trade practices.

THE EFFECT OF UNSATISFACTORY DELIVERIES OF AMERICAN GRAIN.

European interest in the condition of grain, and especially the condition of corn, in the United States, as well as in the cargoes of such grain arriving in Europe, is very keen, and the means of disseminating information is good. Information to the effect that the corn is in poor condition or that one or more cargoes have arrived in Europe in a damaged condition has been known to cause a considerable apprehension among the importers, resulting in sufficiently reduced bids to cover the presumably greater risk in purchasing and in some cases the avoidance for long periods at a time by some importers of purchases of corn from the United States, in favor of corn from other countries in which the moisture content is generally not so high, their risk in handling consequently not so great, and which may generally be purchased upon European terms or upon a basis of arbitration in Europe of any differences arising out of the transactions.

AMERICAN CORN PREFERRED.

Generally the American Dent corn, "Flat maize," as it is known in Europe, is preferred to the corn from most of the other corn-exporting countries, because better results are said to have been obtained from its use when it is received in good condition. This is especially true with the distilling interests, which use large quantities of corn and are said frequently to pay large premiums for American corn when it is not plentiful on the European markets.

Prominent grain merchants of nearly all of the grain markets of the grain-importing countries of Europe were questioned regarding

the relative prices that should be obtainable for American corn, as compared with the prices obtainable for corn from other exporting countries under equal and normal market conditions, provided the American corn was delivered in Europe in equally good condition as that from other countries.

In Great Britain the consensus of opinion as expressed was that American corn would bring at least 1 shilling per quarter (equal to 2.8 cents per bushel) more, although some merchants maintained that it would be worth from 1½ to 2 shillings per quarter more; while in France, Germany, and the Netherlands the invariable answer was that American corn under such conditions would command at least 5 per cent higher prices than the corn from Argentina and most other corn-exporting countries.

LONDON CORN (MAIZE) PRICES.

Observations from time to time during the past several years of the various European market reports have indicated that the prices quoted for American corn upon those markets were often lower and fluctuated at times to a greater degree than seemed reasonable or than was the case with the prices quoted for corn from most other corn-exporting countries.

Table XI shows, in addition to the average of the monthly prices quoted for "No. 2 Corn" at Chicago in cents per bushel, the average of the prices (ex granary) for American corn, compared with the average of the prices for corn from other exporting countries quoted "off stands," Mark Lane, London, as reported each Monday by the Mark Lane Express in shillings and pence per quarter of 480 pounds of corn, for a period of six years, extending from July 1, 1902, to June 30, 1908, these quotations being reduced to equivalents in cents per bushel. The Chicago prices shown in the table are based upon the average of the high and low prices for each month, and the London prices are based upon the average of the high and low prices for each week as quoted. That is to say, that the prices shown were obtained by averaging the highest price and the lowest price quoted for the period in each case. In the London prices quoted the range for any one week in the prices for the corn of any individual country seldom exceeded 1 shilling per quarter, but the range was more often 6 pence to 1 shilling per quarter.

This method does not, of course, give the average prices obtained or that were obtainable as considered from the standpoint of the number of bushels bought or sold, but so far as data are available it shows the average of values per unit of measure for the indicated limited periods, and the prices shown are comparable upon that basis only.

The table is divided into periods of three months, the number of weeks the corn of the various countries was quoted as being on the

market at one and the same time during each three-month period being shown, together with the average price quoted for the corn of each country for each period. From this table it will be seen that the average of the prices quoted for American corn for 301 weeks of the whole period of six years was 66.13 cents per bushel; that for 288 weeks of the whole period the average of the prices quoted for corn from Argentina was 65.9 cents per bushel; while for another 288 weeks of the period the average of the prices quoted for Russian corn was 69.55 cents per bushel.

American, Argentine, and Russian corn were quoted as having been on the market 275 of the same weeks during the whole period, and the averages of those quotations are as follows: American, 66.16 cents; Argentine, 65.75 cents, and Russian, 69.54 cents per bushel, respectively.

Based upon the average prices shown for each three-month period and the number of weeks the corn of the various countries was quoted as having been on the market during each of those periods, American corn was quoted at an average of 8.82 cents per bushel above the average quotations for all corn on the market at the same time during the period ended September 30, 1902, and 2.79 cents per bushel above the average of quotations for all corn on the market at the same time during the period ended December 30, 1902.

During the two following periods, ended March 31 and June 30, 1903, the averages for American corn were, respectively, 3.86 cents and 4.73 cents per bushel below the averages of the quotations for all corn on the market at the same time during those periods. By referring to the periods ended March 31 and June 30, 1905, it will be seen that the averages of the quotations for American corn were below the averages of quotations for all corn for those periods, 9.63 cents and 9.28 cents per bushel, respectively, and during the period ended March 31, 1906, the average of the quotations for American corn reached 11.8 cents per bushel below the average of the quotations for all corn on the market during that period. Since July 1, 1906, the prices as shown have been more favorable to the American corn.

Based upon the London prices quoted for all corn on the market during the whole period of six years, and considered by the number of weeks the corn of each country was quoted during the period, the average of the quotations for American corn was 1.42 cents per bushel below the average of the prices quoted for the corn of all countries on the market for the whole period.

Based upon the prices quoted for all corn on the market for the 288 weeks previously referred to out of a total of 301 weeks, the prices quoted for Argentine corn averaged 1.69 cents per bushel below and for another 288 weeks Russian corn averaged 2.05 cents per bushel above the averages of the prices quoted for the corn of all countries for a like number of the same weeks.

TABLE XI.—*Average monthly prices quoted for "No. 2 Corn" at Chicago and average prices of American corn and corn from other countries as quoted "off stands," Mark Lane, London, England, 1902 to 1908.*[a]

For three months ended—	Chicago.	Weeks.[b]	American.	Argentine.	Russian.	Roumanian.	Bulgarian.	Hungarian.	Turkish.	Indian.	North African.	South African.	Average.	American corn.	
														Above.[c]	Below.[d]
1902.	*Cents.*	*No.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
September 30	62.92	13	77.51	66.11	66.46	66.41	.....	69.22	66.46	.....	.....	.....	68.69	8.82	.....
December 31	54.71	13	76.64	72.96	73.34	73.15	.....	74.43	72.58	.....	.....	.....	73.85	2.79	.....
1903.															
March 31	44.40	12	67.44	70.16	72.47	72.38	.....	73.06	72.29	.....	.....	.....	71.30	.....	3.86
June 30	46.04	13	62.26	.....	69.22	69.33	.....	.....	.....	67.14	.....	.....	66.99	.....	4.73
September 30	50.58	13	65.18	63.24	64.41	64.41	.....	.....	.....	64.36	.....	.....	64.32	.86	.....
December 31	43.40	12	58.78	57.51	59.40	59.37	.....	.....	.....	60.73	.....	.....	59.16	.....	.38
1904.															
March 31	49.38	13	59.50	58.35	59.20	58.79	.....	.....	.....	.....	.....	.....	58.96	.54	.....
June 30	52.23	13	57.81	57.94	57.67	57.67	.....	.....	.....	.....	.....	.....	57.78	.03	.....
September 30	51.67	13	63.50	60.95	63.95	64.14	.....	.....	.....	.....	.....	.....	63.14	.36	.....
December 31	51.31	11	64.90	60.51	77.25	77.42	.....	.....	74.90	.....	.....	.....	71.00	.....	6.10
1905.															
March 31	44.58	13	60.18	66.41	82.86	.....	.....	.....	.....	.....	.....	.....	69.81	.....	9.63
June 30	52.75	11	62.90	70.16	80.90	.....	.....	.....	78.06	69.93	71.09	.....	72.18	.....	9.28
September 30	54.75	13	68.13	67.77	77.35	.....	.....	.....	74.51	.....	.....	.....	71.94	.....	3.81
December 31	48.96	13	69.44	68.43	.....	.....	.....	.....	.....	.....	.....	.....	68.93	.51	.....
1906.															
March 31	42.29	11	59.25	68.06	80.77	76.12	.....	.....	.....	.....	.....	.....	71.05	.....	11.80
June 30	48.96	13	63.32	66.82	74.35	71.51	71.51	.....	.....	68.02	74.35	.....	69.97	.....	6.65
September 30	49.88	13	64.28	60.54	63.51	62.69	62.42	.....	.....	60.92	65.18	.....	62.79	1.49	.....
December 31	44.88	14	63.28	59.10	61.03	61.03	61.03	.....	.....	.....	.....	.....	61.09	2.19	.....
1907.															
March 31	43.08	12	60.73	61.56	60.91	61.03	.....	.....	.....	.....	.....	.....	61.06	.....	.33
June 30	51.13	13	65.61	68.02	66.16	65.91	.....	.....	.....	.....	.....	.....	66.43	.....	.82
September 30	57.83	14	68.86	69.82	68.99	68.91	.....	.....	.....	.....	.....	.....	69.15	.....	.29
December 31	59.54	13	77.02	74.53	76.01	76.34	.....	.....	.....	.....	.....	.....	75.98	1.04	.....
1908.															
March 31	59.58	13	73.28	73.12	72.41	73.12	.....	.....	.....	.....	.....	73.83	73.15	.13	.....
June 30	70.71	9	78.65	75.73	76.80	77.03	.....	.....	.....	.....	.....	.....	77.06	1.59	.....
Average	57.22	.....	66.13	65.90	69.55	67.58	64.88	72.21	72.96	65.12	70.16	73.83	67.55	.....	1.42

[a] The Chicago prices are based upon the average of the high and low monthly prices in cents per bushel, and the London prices are based upon the average of the high and low weekly prices reduced to cents per bushel.

[b] The number of weeks during each period that the corn of the countries for which prices are shown was on the London market at one and the same time.

[c] Average price for American corn *above* average price for all corn for the period specified in cents per bushel.

[d] Average price for American corn *below* average price for all corn for the period specified in cents per bushel.

TABLE XII.—*Average prices quoted for American corn and corn of other countries on Mark Lane, London, England, during fragmentary parts of the period covered by Table XI and therefore not comparable on the basis of the period arrangement of that table.*

Periods (dates inclusive).	Weeks.[a]	American.	Argentine.	Russian.	Roumanian.	Bulgarian.	Turkish.	Indian.	North African.	South African.	Average.	American corn.	
												Above.[b]	Below.[c]
	No.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
1904, January 4 to February 1	5	60.03	55.99	58.76	58.12	.....	.....	59.61	.....	.....	58.50	1.53	.....
1904, August 15 to September 26	7	65.84	63.56	67.87	68.12	.....	65.03	.....	.....	.....	66.08	.....	0.24
1905, January 2 to January 23	4	61.91	63.24	80.90	.....	80.90	.....	.....	.....	.....	71.74	.....	9.83
1905, January 30 to March 27	9	59.41	67.81	83.74	.....	.....	80.90	66.86	.....	.....	71.74	.....	12.33
1905, July 3 to August 28	9	69.07	68.91	78.93	.....	.....	76.09	72.62	72.62	.....	73.04	.....	3.97
1905, October 2 to November 20	8	69.10	68.08	73.45	.....	.....	70.61	.....	.....	.....	70.31	.....	1.21
1906, March 12 to March 26	3	55.35	66.94	79.48	75.29	72.38	.....	71.44	75.29	.....	70.88	.....	15.53
1906, October 1 to November 5	6	65.29	59.67	61.50	61.50	61.50	.....	61.38	64.22	.....	62.15	3.14	.....
1907, January 7 to February 25	8	61.25	61.03	61.38	61.34	60.72	.....	.....	.....	.....	61.14	.11	.....
1907, November 25 to December 30	6	74.39	73.15	72.74	73.15	.....	.....	.....	.....	74.39	73.56	.83	.....
1908, April 6 to April 27	4	74.60	73.89	74.42	75.19	.....	.....	.....	.....	75.13	74.65	.....	.05
Average		65.37	65.72	72.13	66.48	66.45	73.73	66.75	70.27	74.69	68.44	.....	3.07

[a] The number of weeks during each period that the corn of the countries for which prices are shown was on the London market at one and the same time.
[b] Average price for American corn *above* average price for all corn for the period specified in cents per bushel.
[c] Average price for American corn *below* average price for all corn for the period specified in cents per bushel.

LONDON CORN PRICES FOR FRAGMENTARY PERIODS.

Table XII is supplementary to Table XI and compares the prices quoted at London for American corn and those quoted for corn of other corn-exporting countries, especially corn from Bulgaria, Turkey, India, and North and South Africa, when the corn of the latter countries was on the market for fragmentary parts of the periods shown in the preceding table and was therefore not comparable in that table.

The data shown in this table were derived from the same sources, and the results were obtained through the same processes as were those in the preceding table. The quotations shown for American, Argentine, and Russian corn are necessarily duplicated, but those for the other countries shown are not.

The table shows the averages of the quotations for a total of 69 weeks, during 29 weeks of which the quotations for American corn averaged above and during 40 weeks of which those for American corn averaged below the average of all quotations for the respective periods, showing a total average for the whole period of 69 weeks of 3.07 cents per bushel below the average of quotations for all corn shown.

Quotations for "Cinquantina" corn have been omitted from these tables. This corn is similar to the pop corns of the United States, is composed of small, hard, and flinty kernels, is very much prized, especially in Great Britain, for feeding to poultry and pheasants, and usually brings much higher prices than corn of the ordinary commercial classes.

CORN PRODUCTION, EXPORTS AND DOMESTIC VALUES.

With regard to the economic factors which influence corn prices, those of supply and demand naturally occupy a prominent place and in order to enable the reader to weigh those factors and without attempting to draw elaborate conclusions therefrom, the following diagram and tables, which deal with the production, exports, and domestic values of corn, are inserted.

Figure 7 is a diagram showing the production of corn, in 10 million bushels, in the United States, the exports of corn (including corn meal), in 1 million bushels, from the United States, and the average of the high and low prices of December "No. 2 Corn" at Chicago, in cents per bushel, each year for forty years, from 1868 to 1907, inclusive.

The diagram shows the enormous general increase in the production of corn in the United States during the past forty years, the curves of export following the curves of production with remarkable fidelity up to the year 1896. During the years from 1896 to 1900, inclusive, the exports reached the highest points shown for the whole

period. From 1901 to 1907, inclusive, or during the last seven years of the period, the exports compared with the production show a remarkable proportionate decrease in the foreign corn trade.

The curves of export compared with the curves of price show prior to 1902, where the exports of any one year reached 50 million bushels or more, that the average Chicago December price, on the basis before mentioned, was 40 cents per bushel or below, with the following exceptions: During 1875, 50 million bushels were exported at 43 cents per bushel; during 1876, 72½ million bushels at 41½ cents; during 1877, 87

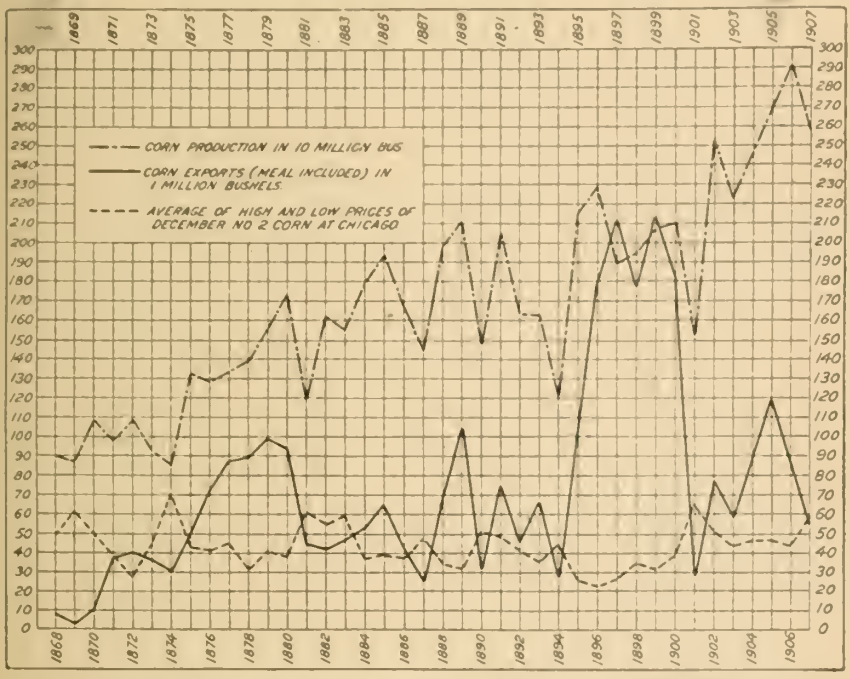

FIG. 7. Diagram showing the production of corn, in 10 million bushels, in the United States, the exports of corn (including corn meal), in 1 million bushels, from the United States, and the average of the high and low prices of December "No. 2 Corn" at Chicago, in cents per bushel, each year for forty years, from 1868 to 1907, inclusive.

million bushels at 46 cents; during 1879, 99½ million bushels at 41⅛ cents, and during 1891 there were exported 76½ million bushels at 49 cents per bushel. From 1902 to 1907, inclusive, or during the last five years of the period, the exports each year have exceeded 50 million bushels and the December price has remained above 40 cents per bushel. The largest quantity exported at the highest December price during any one year for the whole period was during 1905 when 119 million bushels were exported at an average Chicago December price of 46½ cents per bushel.

CORN PRODUCTION IN EXPORTING COUNTRIES.

Table XIII shows the percentages of the world's corn crops produced in the five principal corn-exporting countries of the world each year for a period of ten years, from 1898 to 1907, inclusive. During the whole period these countries together produced an average by years of 83.4 per cent, while the United States alone produced an average of 75.18 per cent of the world's corn crops. Argentina stands next to the United States in the production of corn and in showing the most substantial increase in the quantity produced.

TABLE XIII.—*Percentages of the world's crops of corn produced in the five principal corn-exporting countries during the years from 1898 to 1907, inclusive.*

Country.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	Average.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Per cent.*
United States	71.71	76.29	75.37	64.34	79.20	73.17	79.35	78.49	75.32	78.55	75.18
Argentina	2.09	2.42	2.01	4.18	2.63	4.82	5.63	4.08	5.01	2.17	3.50
European Russia	1.71	1.13	1.22	2.87	1.51	1.63	.83	.96	1.82	1.54	1.52
Roumania	3.80	1.02	3.04	4.94	2.13	2.60	.64	1.71	3.37	1.74	2.50
Bulgaria	1.42	.73	.64	1.06	.56	.75	.41	.57	.51	.36	.70
	80.73	81.59	82.28	77.39	86.03	82.97	86.86	85.81	86.03	84.36	83.40

PERCENTAGES OF CORN CROPS EXPORTED FROM EXPORTING COUNTRIES.

Table XIV shows the percentage of the corn crops exported from the five principal corn-exporting countries of the world each year for a period of ten years, from 1898 to 1907, inclusive. From this table it will be seen that an average, considered by years, of more than one-half of the corn produced in Argentina and more than one-half of that produced in European Russia was exported from those countries during the period; that more than one-third of the crops of Roumania and Bulgaria was exported; while the exports from the United States for the same period amounted to only 4.86 per cent of the production, the exports from the United States showing a gradual reduction in the percentage of the yearly exports. In considering this table, however, it must be remembered that the statistics relating to the United States are based upon a year beginning July 1, while those relating to the other countries shown are based upon the calendar year, and also that the crops in Argentina ripen and are exported practically six months before those of the other countries shown.

TABLE XIV.—*Percentages of the corn crops of the five principal corn-exporting countries that were exported during the years from 1898 to 1907, inclusive.*

Country.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	Average.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*Per cent.*
United States[a]	9.20	10.25	8.60	1.84	3.05	2.59	3.85	4.43	2.94	2.07	4.86
Argentina	50.11	66.39	50.49	43.30	55.89	55.61	55.48	62.19	54.39	70.03	56.52
European Russia	62.33	54.69	35.87	28.04	91.18	50.24	71.88	22.11	14.01	75.86	51.12
Roumania	43.28	84.56	20.09	30.09	62.83	38.72	92.04	2.43	18.24	20.16	42.14
Bulgaria	13.82	30.25	8.89	39.52	43.54	22.28	76.49	19.69	27.03	86.62	36.81

[a] Exports from the United States are for the year beginning July 1, from the other countries for the calendar year specified.

THE INTERNATIONAL TRADE IN CORN.

Table XV shows the percentages of the total international trade in corn represented by the exports of the five principal corn-exporting countries each year for a period of eight years, from 1901 to 1907, inclusive. The deductions were made from a table of exports, which, together with a table of imports, is published in the Yearbook of the Department of Agriculture under the caption "International Trade in Corn and Corn Meal." It is not claimed that the figures given in those tables are exact, but that they represent substantially the international corn trade of the world.

On the basis of this table it will be seen that for the whole period the five countries shown supplied an average of 92.1 per cent of the total international trade in corn; that the United States and Argentina each supplied an average of more than one-third of that trade. It will also be seen that from 1901 to 1905, inclusive, the percentages supplied by the United States increased rapidly and that since the latter year those percentages decreased almost as rapidly, while the percentages supplied by Argentina show a rapid and substantial increase from the beginning of the period.

TABLE XV.—*The percentages of total international trade in corn represented by exports of the five principal corn-exporting countries during the years from 1901 to 1907, inclusive.*

Country.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	Average.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
United States	17.38	32.72	29.81	36.41	50.51	34.53	29.11	32.49
Argentina	27.19	20.08	38.14	39.19	36.86	42.37	26.57	32.91
European Russia	11.92	18.84	11.65	7.50	3.11	3.95	20.39	11.05
Roumania	28.37	18.37	14.32	7.26	.59	9.47	6.13	12.07
Bulgaria	6.14	3.37	2.34	3.95	1.64	2.27	5.39	3.58
	91.00	93.38	93.26	93.95	92.71	92.59	87.59	92.10

THE INFLUENCE OF POOR CONDITION UPON CORN PRICES.

The economic features of the world's trade in corn, as represented in the diagram and tables relating to the production, exports, and international trade in that grain, undoubtedly account to a large extent

for the fluctuations and variations in European prices as indicated by the prices quoted for corn on the London market. However this may be, there can be no doubt that one of the important factors that has influenced the fluctuations in the prices of American corn and that originated and has fostered the strong prejudice found existing against that grain, both among importers and consumers in Europe, was the poor and unsatisfactory condition in which many American corn cargoes have been delivered in Europe during the past several years.

A MARKET FOR BETTER QUALITIES OF GRAIN.

There seems to be every evidence that there is in Europe, and more especially in Great Britain and Germany, a market for the better classes and varieties of American grain in good condition at higher prices. There can be no doubt that the wide range and great variations in the condition and quality of the recognized best export grades of corn and wheat of the Atlantic and Gulf ports, of which under the present grain-trade practices there is practically but one grade for each kind or class of grain and into which the greater bulk of the grain exported from those ports has been included, have to a large extent precluded the possibility of discrimination by the buyer in favor of the better classes and qualities of grain, because of the fact that practically all of the grain exported is sold and purchased upon certificates of grade, issued at the time of loading at the American port and upon which final settlement is usually made before the cargo reaches Europe. This method of doing business is undoubtedly very desirable from the grain-trade standpoint, as it simplifies and facilitates the handling of a business of considerable proportions, but it is also desirable that the grades of grain upon which trades are based have a less wide range in quality and condition for the reason that the grading as at present practiced tends to reduce values to a basis of the lowest common level for each kind or class of grain.

With the exception of a comparatively few of the best-posted importers, the European trade, and especially the consuming trade, is inclined to look at American grain from a common standpoint and to condemn all American grain for iniquities that may be practiced in the grading of grain at any one point. It is, therefore, also desirable that the grades of grain for export, at least in their essential fundamental requirements, such as the limits of moisture, the soundness, and the natural development of the grain, should be alike at all points. Considered as a whole, the European trade desires this in order to facilitate business, and there seems to be no sound economic reason why it should not be so.

THE COLOR AND APPEARANCE OF CORN.

As a general statement it may be said that with respect to the size of kernel the corn of most other countries usually found upon the markets of Europe is about two-thirds the size of the American corn, is generally round in shape, flinty in character, and does not differ materially in appearance from the flint corn grown in some of the New England and Middle States.

Hence the commercial designation of "Round maize." The term "Flat maize" applies largely to American corn, although considerable quantities of corn known as "flat maize" are received from Roumania and adjacent territory, but this corn does not differ materially, in size and appearance at least, from the round maize. Some small shipments of entirely white corn and of entirely yellow corn have of late been received in Europe from South Africa which in size, shape, and appearance tally almost exactly with some varieties of American corn.

The color of the corn from all countries except the United States is either almost entirely yellow or entirely white. Generally the corn of the other countries found on the markets of Europe is yellow corn of various shades and usually has a bright, fresh appearance, while American corn is mostly mixed, white, yellow, and other colors, and because of early shelling, while the corn contains high percentages of moisture, and because of much rough handling through elevators, etc., usually presents a rather dull and comparatively inferior appearance. When not purchased for specific purposes as white corn, there is a marked preference in Europe for bright-yellow corn, and this preference undoubtedly militates at times and to some extent against the sale of American corn in some European grain markets. It therefore seems that it would benefit the American export corn trade if more attention was paid to the color of the corn exported.

EUROPEAN COMPLAINTS CONSERVATIVE.

During these investigations it was found that the European complaints of deliveries of American corn were conservative, at least in numbers, as several cargoes were known to have been delivered in Europe in a more or less damaged condition and upon which cargoes no complaints were made because of the conditions of the contracts under which the purchases were made and the apparent uselessness of making complaints. The delivery abroad of corn and other grain shipments in bad condition, as shown, has surely had a detrimental effect upon the export grain trade of the United States and has produced a condition which under the present trade methods precludes fair treatment on its merits of American corn in Europe, a condition that is not desirable at times when the United States has considerable

quantities of corn to sell. With a view toward overcoming as far as possible the undesirable effects of these conditions the following recommendations are made.

RECOMMENDATIONS.

(1) That the moisture content of all grain exported be kept as low as possible, in order that high temperatures, long voyages, and other harmful conditions encountered may not cause it to become heated and damaged in transit.

(2) That corn containing more than 13½ per cent of moisture and wheat containing more than 12 per cent of moisture, at the time of loading, be not stowed in ships against or near unprotected boiler and engine room bulkheads, unprotected propeller-shaft tunnel coverings, or in the coal-bunker holds of ships.[a]

(3) That partially artificially dried corn which before drying contained high percentages of moisture or which had been in a heating condition before being partially dried be not shipped for export.[b]

(4) That corn that has been partially or wholly artificially dried and that has been mixed with corn not dried that contains high percentages of moisture be not shipped for export.[c]

(5) That all corn shipped for export be made as clean as possible and that care be taken to distribute evenly through each hold broken particles of corn, dirt, and foreign matter not removable from the grain, which usually collect under the hatches of the ships during the process of loading.

(6) That grain for export be not loaded into ships when it is raining and that care be exercised not to admit water in any manner into the holds where grain is stowed.

(7) That all shifting boards and all dunnage of every description placed in holds where grain is stowed be dry.

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[a] The investigations of the Office of Grain Standardization into the subject of air-dry grain have not been completed, but sufficient is known from observations made during three years' work to enable it to be said that thoroughly air-dried corn contains about 12 per cent of moisture and that corn considered commercially dry contains about 14 per cent of moisture.

Tests made with wheat considered commercially dry ranged from 9 per cent of moisture in wheat from the Pacific coast to from 12 to 13 per cent of moisture in that from the East and Middle West. Indications are that the air-dry basis of other grains will be found slightly lower than that of corn.

[b] Observations of such corn in storage and in transit have indicated that it was strongly inclined to heat very quickly, especially in ocean transit. Such corn should be thoroughly dried and thoroughly cooled after drying.

[c] As in the case of the corn referred to in the above footnote, such corn also showed a strong tendency to heat quickly in ocean transit. No attempt will be made to explain these phenomena until these investigations have been completed.

(8) That heavy freight, and especially damp cotton or wet lumber, be not stowed in the holds of the ships upon the top of grain for export.

(9) That grain for export be not loaded into ships at any considerable time before they are ready to leave port.

(10) That all grain-carrying ships be provided with additional or "false" bulkheads in such manner as to provide air spaces of from 12 to 18 inches next to and between the boiler and engine room bulkheads and those of the cargo holds; that these false bulkheads and all metal shaft tunnel coverings be reenforced with plank sheathing next to the cargo and that the air spaces thus formed between the bulkheads, as well as the propeller-shaft tunnels, be connected with ventilators, as shown in figure 6.

(11) That when exporting wheat which contains considerable quantities of wild garlic the advisablity of artificially drying and cleaning the wheat in order to remove the garlic be considered.[a]

(12) That the commercial grades of corn for export be recast and the grading be done in such manner that the corn may be bought and sold upon the basis of its dry-matter content, considered together with its apparent quality, and that 12 per cent of moisture be considered as a commercial basis from which to figure corn values.

THE RELATIVE WORTH OF GRAIN ON A DRY-MATTER BASIS.

Table XVI is here inserted as a guide to a better understanding of the relative values of commercial corn upon a dry-matter basis. This table shows the comparative values of the dry-matter content of grain containing from 12 to 25 per cent of moisture, inclusive, and at prices ranging from 40 cents to $1 per unit of measure, that is, per bushel hundredweight, etc. The comparative values as shown in this table, as well as the principle upon which they are based, will apply equally well to all grains, although the air-dry basis of other grains is likely to be found slightly lower in moisture than that of corn.

HOW TO USE THE DRY-MATTER BASIS.

Through the use of this table the relative value of the dry-matter content of grain containing various quantities of moisture may be quickly ascertained. Thus, if grain containing 12 per cent of moisture is worth 40 cents per bushel (or other unit of measure) then grain containing 22 per cent of moisture is worth 35.45 cents, and grain containing 25 per cent of moisture is worth 34.09 cents on the same basis, because corn containing 12 per cent of moisture at 40 cents

[a] Bulletin 100, pt. 3, Bureau of Plant Industry, U. S. Dept. of Agriculture, gives details and results of experiments in artificially drying wheat in order to remove garlic.

TABLE XVI.[a]—*The relative worth of grain on a dry-matter basis, showing the price per unit of measure from 40 cents to $1 and the difference in value for each 1 per cent of moisture from 12 to 25 per cent.*

Moisture content and relative worth per unit of measure.															Worth of each 1 per cent dry matter.
12 per cent.	13 per cent.	14 per cent.	15 per cent.	16 per cent.	17 per cent.	18 per cent.	19 per cent.	20 per cent.	21 per cent.	22 per cent.	23 per cent.	24 per cent.	25 per cent.	
Cents.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cents.*
40.00	39.54	39.09	38.63	38.18	37.72	37.27	36.81	36.36	35.91	35.45	35.00	34.54	34.09	0.4545+
41.00	40.53	40.07	39.60	39.14	38.67	38.20	37.74	37.27	36.81	36.34	35.87	35.41	34.94	.4659+
42.00	41.53	41.05	40.57	40.09	39.62	39.14	38.66	38.18	37.71	37.23	36.75	36.27	35.80	.4773−
43.00	42.51	42.02	41.53	41.04	40.55	40.07	39.58	39.09	38.60	38.11	37.62	37.13	36.65	.4886+
44.00	43.50	43.00	42.50	42.00	41.50	41.00	40.50	40.00	39.50	39.00	38.50	38.00	37.50	.5000
45.00	44.49	43.98	43.47	42.96	42.45	41.93	41.42	40.91	40.40	39.89	39.38	38.87	38.36	.5114−
46.00	45.47	44.95	44.43	43.91	43.38	42.86	42.34	41.82	41.29	40.77	40.25	39.73	39.20	.5227+
47.00	46.47	45.93	45.40	44.86	44.33	43.80	43.26	42.73	42.19	41.66	41.13	40.59	40.06	.5341−
48.00	47.46	46.91	46.37	45.82	45.28	44.73	44.19	43.64	43.09	42.55	42.00	41.46	40.91	.5455−
49.00	48.44	47.88	47.33	46.77	46.21	45.66	45.10	44.54	43.99	43.43	42.87	42.32	41.76	.5568+
50.00	49.43	48.87	48.30	47.73	47.16	46.59	46.02	45.46	44.89	44.32	43.75	43.18	42.62	.5682−
51.00	50.42	49.84	49.26	48.68	48.10	47.52	46.94	46.36	45.78	45.20	44.62	44.04	43.46	.5795+
52.00	51.41	50.82	50.23	49.64	49.04	48.45	47.86	47.27	46.68	46.09	45.50	44.91	44.32	.5909+
53.00	52.40	51.80	51.20	50.59	49.99	49.39	48.79	48.18	47.58	46.98	46.38	45.77	45.17	.6023−
54.00	53.38	52.77	52.16	51.54	50.93	50.32	49.70	49.09	48.47	47.86	47.25	46.63	46.02	.6136+
55.00	54.38	53.75	53.13	52.50	51.88	51.25	50.63	50.00	49.38	48.75	48.13	47.50	46.88	.6250
56.00	55.37	54.73	54.09	53.46	52.82	52.18	51.55	50.91	50.28	49.64	49.00	48.37	47.73	.6364−
57.00	56.35	55.70	55.05	54.41	53.76	53.11	52.46	51.82	51.17	50.52	49.87	49.23	48.58	.6477+
58.00	57.34	56.68	56.02	55.36	54.71	54.05	53.39	52.73	52.07	51.41	50.75	50.09	49.43	.6591−
59.00	58.33	57.66	56.99	56.32	55.65	54.98	54.31	53.64	52.97	52.30	51.63	50.96	50.29	.6705−
60.00	59.32	58.63	57.95	57.27	56.59	55.91	55.23	54.54	53.86	53.18	52.50	51.82	51.14	.6818+
61.00	60.31	59.62	58.92	58.23	57.54	56.84	56.15	55.46	54.76	54.07	53.38	52.68	51.99	.6932−
62.00	61.29	60.59	59.80	59.18	58.47	57.77	57.06	56.36	55.66	54.95	54.25	53.54	52.84	.7045+
63.00	62.28	61.57	60.85	60.14	59.42	58.70	57.99	57.27	56.56	55.84	55.12	54.41	53.69	.7159+
64.00	63.28	62.55	61.82	61.09	60.37	59.64	58.91	58.18	57.46	56.73	56.00	55.27	54.55	.7273−
65.00	64.26	63.52	62.78	62.04	61.30	60.57	59.83	59.09	58.35	57.61	56.87	56.13	55.40	.7386+
66.00	65.25	64.50	63.75	63.00	62.25	61.50	60.75	60.00	59.25	58.50	57.75	57.00	56.25	.7500
67.00	66.24	65.48	64.72	63.96	63.20	62.43	61.67	60.91	60.15	59.39	58.63	57.87	57.11	.7614−
68.00	67.22	66.45	65.68	64.91	64.13	63.36	62.59	61.82	61.04	60.27	59.50	58.73	57.95	.7727+
69.00	68.22	67.43	66.65	65.86	65.08	64.30	63.51	62.73	61.94	61.16	60.38	59.59	58.81	.7841−
70.00	69.21	68.41	67.62	66.82	66.03	65.23	64.44	63.64	62.84	62.05	61.25	60.46	59.66	.7955−
71.00	70.19	69.38	68.58	67.77	66.96	66.16	65.35	64.54	63.74	62.93	62.12	61.32	60.51	.8068+
72.00	71.18	70.37	69.55	68.73	67.91	67.09	66.27	65.46	64.64	63.82	63.00	62.18	61.37	.8182−
73.00	72.17	71.34	70.51	69.68	68.85	68.02	67.19	66.36	65.53	64.70	63.87	63.04	62.21	.8295+
74.00	73.16	72.32	71.48	70.64	69.79	68.95	68.11	67.27	66.43	65.59	64.75	63.91	63.07	.8409+
75.00	74.15	73.30	72.45	71.59	70.74	69.89	69.04	68.18	67.33	66.48	65.63	64.77	63.92	.8523−
76.00	75.13	74.27	73.41	72.54	71.68	70.82	69.95	69.09	68.22	67.36	66.50	65.63	64.77	.8636+
77.00	76.13	75.25	74.38	73.50	72.63	71.75	70.88	70.00	69.13	68.25	67.38	66.50	65.63	.8750
78.00	77.12	76.23	75.34	74.46	73.57	72.68	71.80	70.91	70.03	69.14	68.25	67.37	66.48	.8864−
79.00	78.10	77.20	76.30	75.41	74.51	73.61	72.71	71.82	70.92	70.02	69.12	68.23	67.33	.8977+
80.00	79.09	78.18	77.27	76.36	75.46	74.55	73.64	72.73	71.82	70.91	70.00	69.09	68.18	.9091−
81.00	80.08	79.16	78.24	77.32	76.40	75.48	74.56	73.64	72.72	71.80	70.88	69.96	69.04	.9205−
82.00	81.07	80.13	79.20	78.27	77.34	76.41	75.48	74.54	73.61	72.68	71.75	70.82	69.89	.9318+
83.00	82.06	81.12	80.17	79.23	78.29	77.34	76.40	75.46	74.51	73.57	72.63	71.68	70.74	.9432−
84.00	83.04	82.09	81.13	80.18	79.22	78.27	77.31	76.36	75.41	74.45	73.50	72.54	71.59	.9545+
85.00	84.03	83.07	82.10	81.14	80.17	79.20	78.24	77.27	76.31	75.34	74.37	73.41	72.44	.9659+
86.00	85.03	84.05	83.07	82.09	81.12	80.14	79.16	78.18	77.21	76.23	75.25	74.27	73.30	.9773−
87.00	86.01	85.02	84.03	83.04	82.05	81.07	80.08	79.09	78.10	77.11	76.12	75.13	74.15	.9886+
88.00	87.00	86.00	85.00	84.00	83.00	82.00	81.00	80.00	79.00	78.00	77.00	76.00	75.00	1.0000
89.00	87.99	86.98	85.97	84.96	83.95	82.93	81.92	80.91	79.90	78.89	77.88	76.87	75.81	1.0114−
90.00	88.97	87.95	86.93	85.91	84.88	83.86	82.84	81.82	80.79	79.77	78.75	77.73	76.70	1.0227+
91.00	89.97	88.93	87.90	86.86	85.83	84.80	83.76	82.73	81.69	80.66	79.63	78.59	77.56	1.0341−
92.00	90.96	89.91	88.87	87.82	86.78	85.73	84.69	83.64	82.59	81.55	80.50	79.46	78.41	1.0455−
93.00	91.94	90.88	89.83	88.77	87.71	86.66	85.60	84.54	83.49	82.43	81.37	80.32	79.26	1.0568+
94.00	92.93	91.87	90.80	89.73	88.66	87.59	86.52	85.46	84.39	83.32	82.25	81.18	80.12	1.0682−
95.00	93.92	92.84	91.76	90.68	89.60	88.52	87.44	86.36	85.28	84.20	83.12	82.04	80.96	1.0795+
96.00	94.91	93.82	92.73	91.64	90.54	89.45	88.36	87.27	86.18	85.09	84.00	82.91	81.82	1.0909+
97.00	95.90	94.80	93.70	92.59	91.49	90.39	89.29	88.18	87.08	85.98	84.88	83.77	82.67	1.1023−
98.00	96.88	95.77	94.66	93.54	92.43	91.32	90.20	89.09	87.97	86.86	85.75	84.63	83.52	1.1136+
99.00	97.88	96.75	95.63	94.50	93.38	92.25	91.13	90.00	88.88	87.75	86.63	85.50	84.38	1.1250
100.00	98.87	97.73	96.59	95.46	94.32	93.18	92.05	90.91	89.78	88.64	87.50	86.37	85.23	1.1364−

per bushel contains 88 per cent of dry matter, and each 1 per cent of dry matter is therefore worth $\frac{1}{88}$ of 40 cents, which equals .4545+ of 1 cent; corn containing 22 per cent of moisture which contains but 78 per cent of dry matter would, on the same basis, be worth 78×.4545+ of 1 cent, or 35.45 cents, per bushel, and corn containing 25 per cent of moisture and 75 per cent of dry matter would be worth 75×.4545+ of 1 cent, or 34.09 cents, per bushel on a dry-matter basis. The worth of each 1 per cent of dry matter for each price per unit of measure given is shown in the column at the right of the table.

The table may be used either way to ascertain these relative values. As, for instance, if a maximum of 16 per cent of moisture is allowed in "No. 2 Corn" and that grade of corn is worth 70.64 cents per bushel, then corn of the same grade containing only 12 per cent of moisture would be worth 74 cents per bushel, while corn containing 22 per cent of moisture would be worth but 65.59 cents per bushel on a dry-matter basis.

THE RATIO OF THE MOISTURE CONTENT TO THE DETERIORATION OF GRAIN.

It will be noted in the table that no account is taken of the accelerated risk from deterioration in grain as its moisture content is increased, nor the consequent reduction in value of the grain for storage and transportation purposes.[a] It will also be noted that the difference in value per each 1 per cent of dry matter increases in direct proportion to the increase in the price, so that as the prices of grain increase the differences in value per each 1 per cent of dry matter or of moisture become of more material importance to the producer and consumer of grain. These greater differences in actual value in the higher priced grain are sufficient to reimburse the producer or seller for the cost of reducing the moisture content of the grain and to enable the consumer to purchase it at the increased cost, provided the grain is bought and sold on a basis of its dry-matter content.

SUGGESTIONS RELATIVE TO GRADING CORN.

The results of these investigations so far as they have progressed, indicate that commercial corn, in order to fix its intrinsic worth as nearly as possible by grades, should be divided into at least two classes: (1) To include only well-matured and well-developed corn containing not more than 2½ per cent of field or mold damaged

[a] It is confidently hoped that the investigations now being carried on by the Office of Grain Standardization will throw some light upon the ratio of increased risk to increased moisture in commercial grains for storage and transportation purposes.

kernels, and (2) to include the ordinary sorts of commercial corn containing not more than 5 to 6 per cent of field-damaged kernels (commercial basis, heat-damaged or "mahogany" kernels excluded),[a] regardless of the moisture content of the corn, that each of the suggested classes be subdivided into grades based upon the moisture content of the corn, that no one grade should contain a greater range than 2 per cent of moisture,[b] and that no corn should be graded, shipped long distances, put into storage, or exported on grades unless it be commercially clean and free from indications of fermentation.

The necessity for some arrangement of this kind in the grading of corn and for more care in the methods of handling corn becomes more apparent as the prices and values of grain continue to increase, and as they continue to increase the advisability of still narrower limits of moisture within the grades will become more apparent.

Approved:

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *February 8, 1910.*

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[a] The analyses of samples taken from various cargoes of corn, representing approximately 4½ million bushels of all grades exported from the United States during November and December, 1908, and February, March, April, and October, 1909, showed a maximum of 10.2 per cent (December, 1908), a minimum of 2 per cent, and an average of about 2.5 per cent of field and mold damaged kernels. The maximum of 10.2 per cent was unusual and undesirable. It is the opinion of the writers that corn containing more than 5 to 6 per cent of such damaged kernels and also corn containing heat-damaged or "mahogany" kernels, should be bought and sold "on samples" or on special grades.

[b] Bulletin 99, Bureau of Plant Industry, U. S. Dept. of Agriculture, describes the Brown and Duvel apparatus for and method of making moisture determinations in grain quickly. The apparatus has been recommended by the Department of Agriculture and is extensively used in the grain trade for the purpose.

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